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APPENDICES

- A. Chemical Abstracts Registry Numbers (CAS #'s)
- B. List of Standard Operating Procedures (SOPs).

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This Quality Manual supports audit programs and/or certifications with the following agencies:

Certifying Agency	ATL Certificate #	Basis of Certification/Approval
California Department of Health Services	1149	Onsite audit (biennial) and WP PEs
New York State Department of Health	11291	Onsite audit (annual) and NY PEs
Arizona Department of Health Services Certificate	AZ0567	Onsite audit (annual) and WP PEs
State of Utah Department of Health Certificate	E-217	Onsite audit (biennial) and WP PEs
Air Force Center for Environmental Excellence	NA	Guidance under AFCEE 3.0 QAPP, April 1998
US Army Corps of Engineers	NA	SOP Review & Submission of PE Samples
Naval Installation Restoration	NA	Guidance under NIR Laboratory Quality Assurance Guide, February 1996

*At ATL we strive to be the **BEST** in everything that we do. Our very existence is based on our continued ability to provide innovative, dependable and cost effective environmental services to our clients. We **CARE** about our clients as well as our co-workers and manage our daily activities to build relationships based on mutual trust, honesty and respect. We are **LEADERS** in our field and accept the risks associated with building new frontiers in our personal as well as corporate lives. Our strength comes from our **TEAMS** for through them we can achieve our goals.*

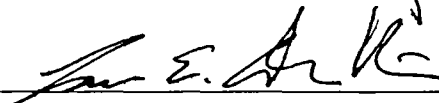
Linda L. Freeman
 President



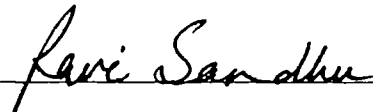
Robert R. Freeman
 Vice President



Lenore Della Villa
 Director of Operations



Ravinder Sandhu
 Quality Manager



1.0 INTRODUCTION

The ATL Quality Manual describes the Quality Assurance program and Quality Control procedures used to ensure that data of known, documented quality are produced. It is designed to be used as a manual which outlines the process by which we ensure customer expectations are met. ISO Guide 25-*General Requirements for Competence of Calibration and Testing Laboratories* were incorporated wherever possible.

The Quality Manual contains a discussion of the following topics.

1.0 Introduction to Systems

Customer focus, systems-based management & information systems.

2.0 Organization

Structure, qualifications & responsibilities of staff, facilities & equipment.

3.0 Quality Program

Project management, SOPs & training, evaluating & documenting adherence to QA/QC requirements, corrective action system, health & safety.

4.0 Quality Objectives

QC parameters & procedures, procedures to establish detection limits and perform calibrations, traceability & preparation of standards.

5.0 Sample Handling

Sampling containers, preservation & Chain-of-Custody requirements, sample receiving & tracking procedures, internal custody, storage & disposal.

6.0 Analytical Methods/Procedures

Method specific QC acceptance criteria.

7.0 Data Review and Reporting

Hardcopy & electronic data production & review, data flagging, data storage.

8.0 Establishing Acceptance Criteria

Generating and evaluating in-house statistical limits

9.0 Preventative Maintenance

Routine maintenance & service contracts, control of miscellaneous monitoring equipment.

10.0 Audits and PE Samples

Brief review of internal and external audits programs.

11.0 Computer and Software Systems

Data storage and back-up routines as well as internal software validation efforts.

12.0 Control of Purchased Items

Overview of purchase requisition system

1.1 QUALITY OBJECTIVE

Air Toxics Limited is committed to producing data which meets or exceeds the client's measurement needs. Customer satisfaction is the motivating force behind most ATL processes. An underlying network of systems designed to define, document and process each individual customer need supports this primary objective. This systems network includes marketing/sales, project management, computer MIS, laboratory production, method development, mobile services, quality assurance and finance. Each of these operational areas is organized around an empowered work team accountable for delivering an automated, on-time, and defensible result.

We believe the ultimate responsibility for quality resides at the team level. Every team member has the responsibility and authority to suspend a process if it appears the quality objectives are not being met. Analytical team members are informed of the quality objectives via documented Standard Operation Procedures (SOPs) and project related information systems (ATL's Project Profiles). Team members work closely with the Project Management and QA departments to ensure quality objectives are met.

Ethical practices relating to data generation are built into the systems via the operational SOP's which describe appropriate as well as inappropriate practices. Additional systems

and training programs which safeguard strict adherence to the SOP's ultimately ensure that ethical practices are employed.

1.2 QUALITY MANAGEMENT SYSTEM

The role of the ATL Management team is to help ensure the quality objective is met through a continuous and reiterative program of process improvements. The management team consists of business directors, area managers and team leaders.

The primary role of the management team is to establish performance goals at the corporate and team levels as well as to develop tools capable of producing quantifiable measures of performance against these goals. (Examples: customer satisfaction index, sales quotas, report turn around time, net profit, days to complete corrective actions, etc.). A secondary role of management is to help ensure that the work environment and facilities promote continued development of empowered work teams through facilities management and programs for recruiting, training and retaining qualified staff.

Quality Assurance: The role of the ATL Quality Assurance Team is to help ensure that the systems described above are designed, documented and operating in accordance with the quality objectives. This is accomplished via coordination and dissemination of internal and external audit information, review of SOP's against

published methods, monitoring of the Quality Manual against actual practices, maintenance of an ongoing Corrective Action Program with quarterly reports to management, and a leadership role in employee training programs. A secondary function of the QA Team deals with data review and other quality control related programs. The QA Team is free from any commercial, financial, or production pressures when making assessments or decisions regarding the quality of work produced or effectiveness of the quality systems. The QA Manager reports directly to the President in order to maintain independence from business operating units and facilitate communications regarding quality related issues.

Communication between the QA and Management teams occurs on a regular basis via weekly status meetings. Information regarding outstanding corrective action items, upcoming audits, audit results or general observations are brought up and documented via a database of agenda notes. This database along with the corrective action database compiles a 'Quarterly Quality Assurance Status Report', which is distributed to the management team for review.

ATL Marketing and Project Management: The role of the ATL Marketing and Project Management teams is to effectively document and communicate the needs of the customer. These teams represent the customer in all matters and

serve as a liaison between customer and the method development, laboratory, finance and quality assurance areas. Information regarding customer needs flows into all ATL systems via these two teams. Interactions can be as complex as QAPP or SOW review or as simple as processing shipments of canisters and other sampling media. Project specifics are documented and stored via an interactive database that assigns a unique identifier for every reference. Sample receiving functions also reside on these teams in order to facilitate customer communication. The goal of the department is to enable every sample to be received and processed into a unique laboratory Work Order within 24 hours of sample receipt. Marketing and Project Management teams report to the Director of Business Development.

Analytical Team Leaders: Laboratory management is divided into two "A to Z" work teams. Each team has the necessary resources to complete sample analysis, review and reporting. There are no separate extractions or reporting groups. In this way, each team sees the end product just as the customer sees it. In this way, team members are more easily able to accept control and accountability for quality. The primary responsibility of the team leaders is to monitor customer need versus resource availability. Staff and equipment management is carefully balanced with customer need. The goal for each team is to deliver defensible numbers in the time frame determined. Special analytical lists,

deliverables or TAT requests are automated via customized linkages (work tools) into the centralized SQL database. Performance measurements against the goal are routinely monitored using the same SQL database. Performance and quality related information is shared with team members during weekly team meetings. Project or client related information resides both in the project management module and sample tracking modules, reducing the need for relying on verbal communication of project specifics to the team. The team leaders report to the Director of Operations.

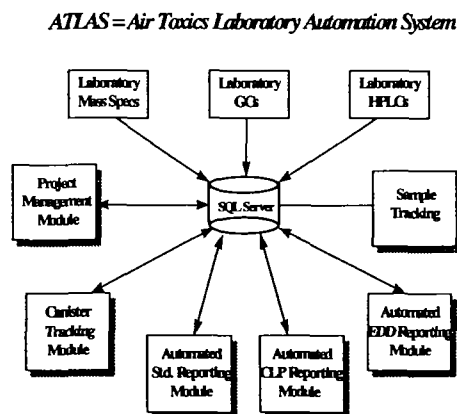
Management Information Systems: The MIS (Management Information Systems) team is responsible for the design and maintenance of the SQL server based data system. Its primary goal is to ensure that customer satisfaction is achieved by the way information is processed or queried. This includes systems relating to email, project management, data acquisition, audit trails, data security and automated data reporting linkages. The group consists of one full time systems administrator and one full time programmer. Around-the-clock systems support is achieved via a combination of in-house and contract support. Additional programmers are brought in on a project specific basis. All of the ATL information systems are designed, coded and tested in house and as such, are proprietary in nature. The MIS team reports to the Director of Operations.

Finance: The ATL Finance team is responsible for monitoring the profitability of the operations. Customer satisfaction goals are built into budgeting, purchasing, invoicing, collections, contracts and banking. The primary goal of the team is help ensure bottom line profitability while achieving customer satisfaction. The Finance team leader reports directly to the CEO.

1.3 INFORMATION MANAGEMENT SYSTEM

All information generated is stored in the ATLAS (Air Toxics Laboratory Automation System) databases using ATL designed hardware and proprietary software. This LIM system is an ongoing development project designed to find more efficient means to meet the customer needs. Each client contact (telephone call, quote, shipping request or complaint) is stored in a database, which can be queried for sample log-in, project backlogs, project TAT or revenue statistics. Virtually any desired field can be queried. Individual modules can use the information stored in the company wide database via a client/server approach.

Some modules are designed to track non-traditional information such as the sample history of individual canisters, number of reports completed per analyst per shift and overdue work by reason code. These types of information directly affect the ability of the management team to provide quality process improvements. Some non-traditional calculations such as the boiling point distribution of a hydrocarbon background, EPA rounding, and percent difference calculations have been made available at the bench. This type of information directly affects the ability of the individual employee to meet the quality objectives.



Note: SQL Server = ATLAS database

2.0 ORGANIZATION

2.1 STAFF QUALIFICATIONS AND RESPONSIBILITIES

There are three business directors, four area managers and four team leaders. Operating areas consist of Marketing/Sales, Quality Assurance, Finance, Mobile Services, Method Development and Lab Operations. Each operating area is lead by an area manager with the exception of Laboratory Operations and Finance, which are lead by Team Leaders. All Managers and Team leaders report to the Directors. In the case of absence, any Director can fulfill the responsibilities of the remaining Directors. In the absence of a Manager or Team Leader, one of the Directors will be named as interim successor.

LINDA L. FREEMAN DIRECTOR OF ADMINISTRATION

Ms. Linda L. Freeman is the Director of Administration and President/CFO of ATL. Ms. Freeman leads programs relating to the development of teams, quality systems and financial infrastructure. She holds a B.S. Degree from Boston College and a M.S. degree in Chemistry from the University of Wisconsin-Madison. Ms. Freeman has 15 years of combined environmental experience and 10 years of laboratory business management experience.

DR. ROBERT R. FREEMAN DIRECTOR OF BUSINESS DEVELOPMENT

Dr. Robert R. Freeman is the Director of Business Development and Vice President of ATL. Dr. Freeman holds a B.S. from the University of Illinois and a Ph.D. in Physical Chemistry from the University of Houston. Dr. Freeman directs programs relating to customer satisfaction, sales and marketing. He directs efforts to develop customized instrumentation and innovative site technologies. Dr. Freeman also directs customer and employee related training efforts. He has 10 years of experience in the field of GC/MS and 15 years experience in laboratory business management.

LENNORE DELLA VILLA DIRECTOR OF OPERATIONS

Ms. Lennore Della Villa is the Director of Operations and MIS manager of ATL. Ms. Della Villa directs the definition, design and operation of the laboratory production and information management systems. Ms. Della Villa leads programs relating to information transfer, sample analysis deliverable generation and performance feedback. She holds a B.S. Degree in Biochemistry from the University of California, and manages a staff of up to 30 chemists, technicians, programmers and hardware technicians. Ms. Della Villa has six years of environmental experience and seven years of laboratory business management experience.

DR. RAVINDER SANDHU QUALITY ASSURANCE MANAGER

Ms. Ravinder Sandu develops strategies and implements programs intended to ensure the laboratory is producing data of known and acceptable quality. Dr. Sandhu oversees QC activities including various independent checks of laboratory systems, SOP generation, and corrective action procedures as well as monitoring laboratory certification programs. Dr. Sandhu has a Doctoral Degree in Environmental Science from the University of Maryland Eastern Shore, followed by nine years experience as an Assistant Professor. Dr. Sandhu has extensive research experience relating to air/water pollution, biology and plant physiology.

CERESS BERWANGER MARKETING/SALES MANAGER

Ms. Ceress Berwanger is responsible for managing sales and marketing efforts including definition of market strategy and oversight of national and regional sales. Ms. Berwanger actively oversees customer training and education via production of a quarterly newsletter and other technical notes. Ms. Berwanger has over 15 years of experience in marketing/sales and data management for environmental labs. Prior work experience includes Senior Account Executive for PACE and ETC Laboratories.

**COLEEN WOLLAM
FINANCE TEAM LEADER**

Ms. Coleen Wollam is responsible for supervising the operation of the finance team including general office management, budgeting, accounts payable, purchasing, accounts receivable, collections and payroll. Ms. Wollam has 6 years of experience in office management and one year of business management. She is currently completing her Bachelors of Business Administration and Business Accounting dual degree at the University of Phoenix and supervises a staff of four.

**L. WADE BONTEMPO
METHOD DEVELOPMENT MANAGER**

Mr. Wade Bontempo is responsible for overseeing hardware and methods development activities. Mr. Bontempo designs, builds and validates customized laboratory and field sampling equipment in support of air related applications. He also manages service support activities for all laboratory equipment and specialized testing devices. Mr. Bontempo has 8 years of chromatographic and new product design experience and is recognized as an expert in the fields of selective detectors and automated valving. He has a B.S. in Biochemistry with a minor in Chemistry from Colorado State University and has taken advanced classes at the University of Savoie, France.

**HEIDI HAYES
LABORATORY TEAM LEADER**

Ms. Heidi Hayes is the team leader for extractables analyses, including semi-volatiles by EPA Method TO-13 and SW-846 8270, PCBs and Pesticides by EPA Method TO-4, BTEX analysis by EPA Method TO-3 and atmospheric gas analysis by ASTM Method D-1946. Ms. Hayes has six years experience in methods development and trace level analyses of environmental samples using various GC, GC/MS and ICP instrumentation. As team leader, Ms. Hayes is responsible for supervising various aspects of production ranging from sample analysis through reporting. She holds a B.S. Degree from Luther College and an M.S. degree in Applied Chemistry from the Colorado School of Mines. Prior to joining ATL, Ms. Hayes was the supervisor of contract chemists at the Rocky Mountain Arsenal, Laboratory

Support Division in Denver. In that capacity, she developed preparation techniques and GC methods, certifying the procedures via U.S. Army performance based protocols. Her previous experience also includes positions as a GC and GC/MS chemist with Phoenix Analytical Laboratories. Ms. Hayes supervises a staff of up to 14 scientists and analysts.

**NATHAN SHAFER
LABORATORY TEAM LEADER**

Mr. Nathan Shafer is the team leader for the GC/MS volatiles analysis, including EPA Method TO-14/TO-15 and VOST/TO17 projects. The team is staffed by up to 12 scientists and analysts. Mr. Shafer has 3 years experience in performing GC and GC/MS analyses for volatile organic compounds and one year of supervisory experience. As team leader, Mr. Shafer is responsible for supervising various aspects of production ranging from sample analysis through reporting. Mr. Shafer has a B.A. Degree in Chemistry and Psychology from Claremont McKenna College in Claremont, CA

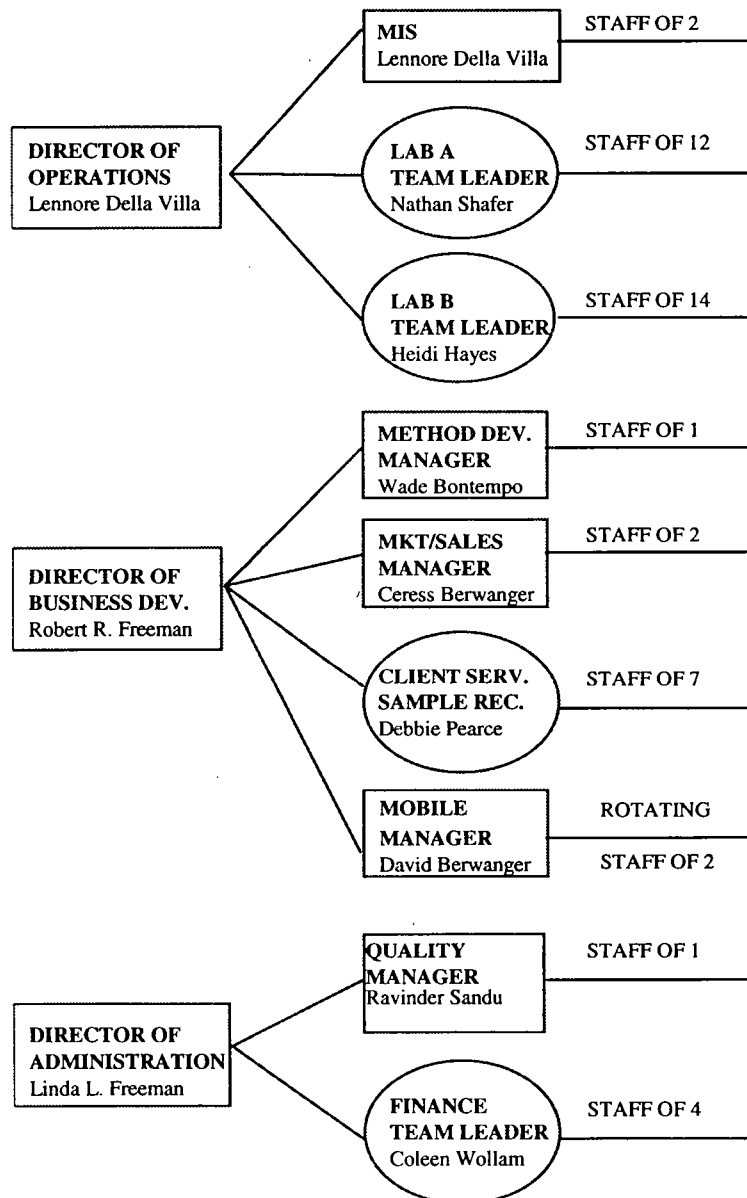
**DEBBIE PEARCE
PROJECT MANAGEMENT TEAM LEADER**

Ms. Debbie Pearce is the team leader for ATL's client services and sample receiving groups. Ms. Pearce supervises a staff of seven and brings over 15 years of environmental experience to the group. Prior to joining ATL she was a client services manager with Compuchem-Chemwest and QA Officer with Radian Corporation. Ms. Pearce is responsible for the quality of customer contacts and relations. Her group maintains the data bases involved with translating customer needs into sample work orders.

**DAVID BERWANGER
MOBILE SERVICES MANAGER**

Mr. David Berwanger serves as manager of the mobile services and is responsible for both project management and sales. Mr. Berwanger holds a B.S. degree in Chemistry from the University of Cincinnati and has held both national and international positions with a variety of instrumentation manufacturers. He had previous environmental laboratory management experience with ETC and three years as an independent business consultant.

EXHIBIT 2.1 ATL Management Organization



2.2 FACILITIES

The laboratory occupies 21,000 square feet of space in Folsom, California with approximately 3000 square feet of office space. The single story building is designed to suit the specifications of an air laboratory. The main instrumentation laboratory is based on an "open" concept designed to facilitate cross-functional work teams. Sample receiving occupies approximately 500 square feet. There is sufficient floor space to receive, unpack and tag up to 150 Summa canisters per day. The main laboratory is centrally located and houses all of the chromatography equipment including ten GC/MS systems, ten GCs, and a network of UNIX based computers. A caged canister storage area was constructed on one side of the laboratory to securely hold up to 200 canister samples. An isolated negative pressure room was designed for solvent handling and extraction activities. Approximately 3000 square feet of air conditioned space is designated for long term file storage, a sample disposal area, and a work shop/tooling area. Sorbent tube preparation and canister cleaning operations are located in segregated areas. Facility security is maintained through a controlled building access system, linked to a commercial security agency.

An Eastern Region sales office is maintained in Shrewsbury, New Jersey. There are no laboratory facilities in this office.

2.3 EQUIPMENT AND INSTRUMENTATION

The laboratory is equipped with over \$2,000,000 of state-of-the-art instrumentation, dedicated exclusively to the analysis of air samples. Much of the commercially available equipment was modified in-house in order to enhance performance. Several pieces of equipment were designed in-house to meet unique customer needs in the areas of:

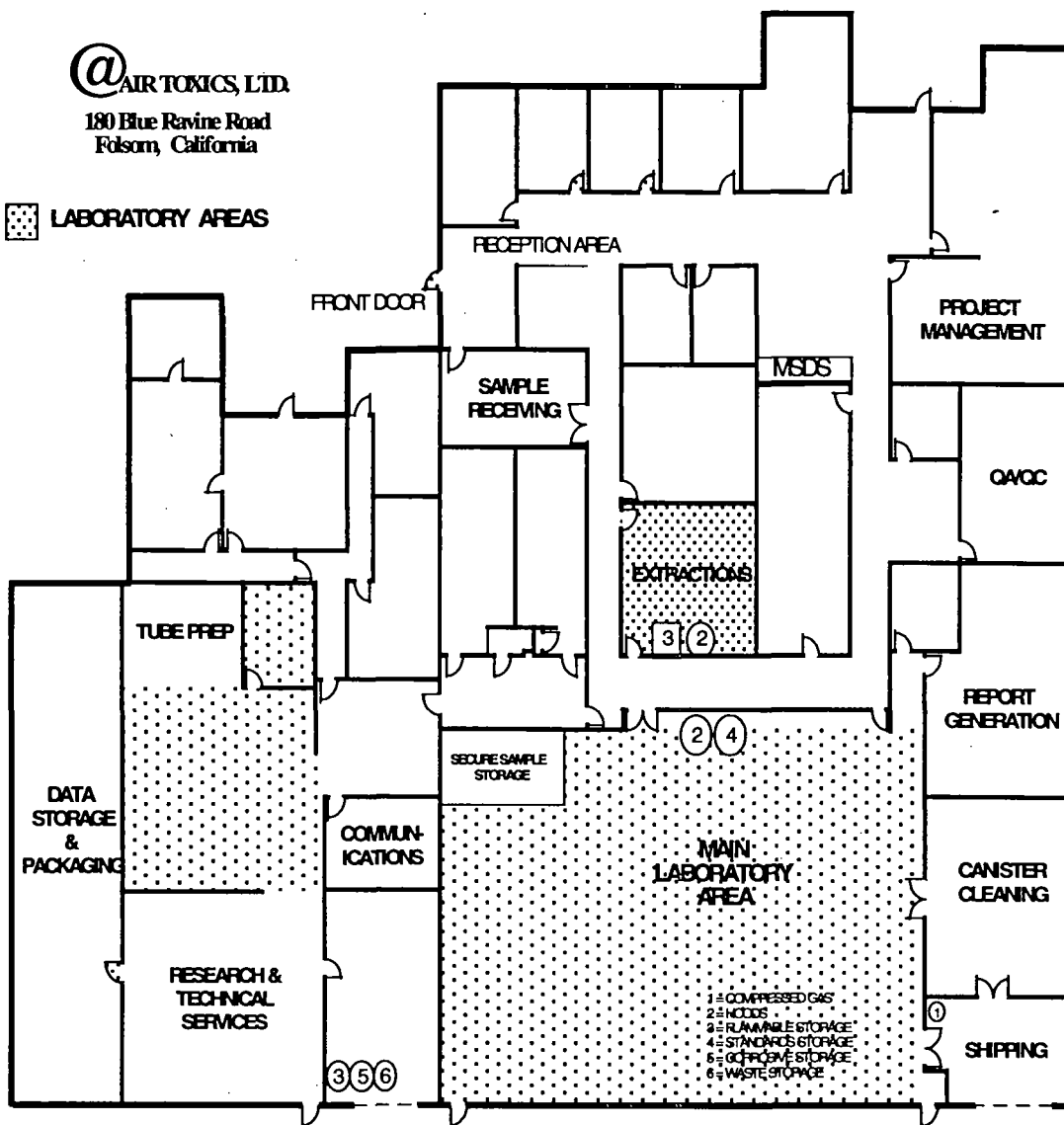
*overcoming challenging sampling problems;
analyzing difficult matrices; and,
achieving greater sensitivity.*

ATL maintains a staff of three design engineers and a 1000 square foot fabrication shop in order to build, test and service the custom equipment.

A facilities map and equipment list can be found on the following pages.

@AIR TOXICS, LTD.
 180 Blue Ravine Road
 Folsom, California

 **LABORATORY AREAS**



File Name: Plan.03 8-16-95 RLM

Laboratory Instrumentation (* Indicates in-house modified)

#	DESCRIPTION	ACQUIRED
7	Hewlett-Packard 5973 GC/MSD	1997, 1998, 1999
1	Hewlett-Packard 5972 GC/MSD	1994
1	Hewlett-Packard 5971 GC/MSD	1993
1	Hewlett-Packard 5970 GC/MSD	1989
1	Varian/Saturn 3 Ion Trap GC/MS	1994
1	Hewlett-Packard 5890 multidimensional valved analyzer	1990
1	Hewlett-Packard 6890 multidimensional valved analyzer	1996*
1	Hewlett-Packard 5890 GC/FID/TCD with gas sample valve	1996
1	Hewlett-Packard 5890 GC/FID/SCD	1994*
1	Hewlett-Packard 5890 GC/FID/FPD	1990
2	Hewlett-Packard 5890 GC/FID/PID	1990, 1992
1	Hewlett-Packard 5890 GC/ECD/ECD	1995
1	Hewlett-Packard 6890 GC/TCD/FID	1998
1	Hewlett-Packard 5890 FID with gas sample valve	1989
2	Hewlett-Packard 7673 with 100 position carousel	1995, 1997
1	Hewlett-Packard 7694 headspace autosampler	1998
1	SIS TD-2 Shortpath Thermal Desorption*	1996*
1	SIS TD-4 Shortpath Thermal Desorption*	1998*
1	Inficon GC/MS Field Portable	1999
1	Kratos Isocratic HPLC/UV-VIS	1994
1	Hewlett-Packard 1050 Gradient HPLC w/ autosampler	1993
8	Tekmar 3000 concentrators	1997, 1998*
2	Zymark TurboVap Concentrators	1993
1	Microsensor Technology Inc. M400 Micro GC	1994
1	Microsensor Technology Inc. P200H Micro GC	1992
2	Custom NOAH TO14 automated sample interface	1998
11	Custom NOAH cart sample manifold	1998, 1999
1	Custom NOAH sample log-in and leak check system	1998
1	Custom NOAH cart cleaning station	1998
1	Custom prefractionator for vinyl chloride analysis	1993
6	Custom Cryotrap Desorption Units	various
2	Custom Sorbent Tube Desorption Unit	1992, 1998
1	Custom Calibration Gas Blending Manifold	various
1	Custom Permeation calibration system	1999
2	Custom Canister pressurization stations	various
4	Custom Convector Pressure/Vacuum Canister Cleaning Manifold	various

Sampling Media

DESCRIPTION	QUANTITY
6-Liter Summa canisters	1150
1-Liter Summa canisters	425
Custom-manufactured fixed Flow Controllers for air sampling canisters	300
Veriflo 24-hour flow controllers for canisters	30

3.0 QUALITY PROGRAM

Air Toxics Limited maintains a comprehensive Quality Assurance program to ensure analyses are being conducted according to prescribed analytical methodology, and are within project specific QAPP requirements. The basic elements of this program include:

- Documenting procedures, method requirements, and project requirements;
- Ensuring laboratory staff are appropriately trained;
- Performing regular assessments of adherence to requirements, including maintenance of a system which documents, tracks, and provides closure when corrective actions are necessary; and,
- Formally communicating results of those assessments to laboratory management.

These elements are described in sections 3.1 - 3.9.

3.1 QUALITY MANUAL

This Quality Manual is required reading for all laboratory staff. In order to maintain comparability and representativeness of the data produced, all laboratory staff are required to comply with the procedures documented in this Quality Manual.

Three official, controlled copies of the Quality Manual are maintained, one in the QA department, one in the laboratory, and one in the company library.

A complete description of ATL's system for generating, updating and distributing the Quality Manual as well as other controlled documents can be found in ATL's SOP #32.

3.2 STANDARD OPERATING PROCEDURES

The laboratory procedures used at Air Toxics Limited are documented in our method-specific standard operating procedures (SOPs). These procedures are based on standard EPA methodology whenever possible. The SOPs contain all necessary QC parameters, acceptance criteria, and directions for corrective action measures.

The SOPs are written by the team leader or an experienced scientist and are reviewed on a yearly basis for technical accuracy and adherence to general QA/QC protocols. The SOP is signed and dated by the author, then is submitted for technical review, QA review, and final review by the laboratory director. Modifications and/or additions to the SOP are similarly reviewed and signed.

Each SOP carries a unique file number, revision number, control copy number, and date of generation. Three official, controlled copies of the SOPs are maintained, one in the QA department, one in the laboratory, and one in the Eastern Region sales office.

A comprehensive list of ATL's SOPs can be found in the Appendix.

3.3 REVISIONS OF REFERENCE METHODS AND SOPS

The revision number of the referenced method is noted in the method-specific SOPs. The protocols and deviations are specific to that revision number. Air Toxics does not operate under more than one version of a referenced method at any one time. The specific protocol used for analysis can be tracked using the effective date noted on the front page of the SOP.

Each SOP update is identified by a unique revision number as well. As with referenced method revisions, only one revision of an SOP is used in the laboratory at any one time.

A complete description of ATL's system for writing and updating SOPs can be found in ATL's SOP #46.

3.4 METHOD DEVIATIONS

Any deviations taken from referenced methods and the reasons for taking them are noted in the SOPs. Approval of these deviations is indicated by the technical review, QA review, and laboratory director review signatures on the front page of each SOP.

3.5 INCORPORATING PROJECT-SPECIFIC QAPP REQUIREMENTS

Project specific QAPPs are reviewed by the QA manager and/or ATL's project manager at a minimum. Team leaders and key scientists often review these documents as well. A summary of the analytical

requirements which differ from ATL's SOPs is included in ATL's internal project database, using ATL's "Project Profiles" (Exhibit 3.1). The project profile is provided to the laboratory in the work order folder accompanying each set of samples.

The project specific QAPPs and internally-created project summaries of analytical requirements are maintained by the laboratory's project manager.

3.6 TRAINING

3.6.1 ANALYTICAL TRAINING

3.6.1.1 Internal training of laboratory staff consists of three developmental stages:

- Initial instruction by the analytical team leader or an experienced staff member concerning basic elements of the method and brief overview of instrumentation. Applicable SOPs and methods are read. During this time the trainee is an observer.
- A period of close contact and direct supervision by an experienced staff member. During this time, which may last several weeks, the analyst performs tasks independently. All aspects of his/her work reviewed by the supervisor or experienced staff member.
- Independent work with data review by the analytical team leader.

Exhibit 3.2 is an example training record summary. It is the responsibility of the analyst to ensure his/her record is kept current. The QA department reviews these records on a yearly basis. Exhibit 3.3 is an example training record review sheet.

Beginning in 1999, a series of classes taught by in-house experts are offered throughout the year. Exhibit 3.4 is a list of internal courses offered. Course attendance is mandatory for topics specifically related to an analyst's job function. Course attendees are tested to ensure acceptable understanding of the material presented. Completion of courses is documented in training records.

3.6.1.2 External training courses offered by instrument manufacturers or other recognized experts in analytical instrumentation and/or analysis are attended by a minimum of two ATL employees per year. The course description, date offered, and record of attendance are kept in the analyst's training records.

3.6.2 QUALITY ASSURANCE TRAINING

Beginning in 1999, attendance of a six part quality assurance course by all ATL employees will be required. A written test, graded by the QA Manager, is given to each attendee to ensure an acceptable level of understanding of the topics covered. Completion of the course is documented in the employee's training record. The course is outlined in Exhibit 3.4.

3.6.3 HEALTH AND SAFETY TRAINING

Lab staff will, on occasion, be exposed to the handling of flammable solvents, compressed gases or toxic calibration standards. Education in the safe handling and disposal of these materials is accomplished as follows:

- Each new employee is given a safety tour of the facility prior to commencing employment.
- The Chemical Hygiene Committee meets quarterly (or more frequently if needed) to discuss safety concerns and ways of improving safety in the work place.
- The Chemical Hygiene Committee schedules on going safety training throughout the year.
- If special precautions must be taken to perform a method, a safety section is included in the method SOP which discusses protocols and other measures for risk reduction through exposure prevention.
- ATL maintains Material Safety Data Sheets (MSDS) for each chemical used on-site. The MSDS are accessible to all personnel in the library area.
- ATL has access to MSDS's on the internet through our vendor, VWR.

3.7 EVALUATING ADHERENCE TO REQUIREMENTS

The QA department ensures established protocols are being followed by:

- Reviewing a minimum of 10% of all analytical and supporting data;
- Performing daily review of corrective action requests (see section 3.8);
- Holding weekly QA meetings with the Director of Administration, the Director of Operations, and the Analytical Team Leaders, to discuss the status of in-house projects, and discuss any QA/QC issues which have surfaced; and,
- Conducting annual internal audits.

3.8 CORRECTIVE ACTION DOCUMENTATION

A request for corrective action (CAR) is initiated any time either the ATL SOPs or client-prescribed QC protocol are not followed, or in any other instance that sample results are adversely affected. This request is documented using ATL's CAR form - see Exhibit 3.5.

By using pre-numbered Corrective Action forms, the status of each corrective action item can be tracked and the follow-up and closure by the QA department is documented. A database is used to track the date of resolution, the necessity for follow-up, and the date the follow-up action was completed.

The status of corrective actions that have not yet been completely resolved (including follow-up actions) are tracked by filing those forms separately from forms associated with completed corrective action items.

Should a malfunction occur with a pending sample, the client is contacted prior to analysis to confirm that analysis is desired. Any malfunction affecting data quality is detailed in the laboratory narrative. The CAR form is filed with the work order as a permanent record of the nature of the problem and the resolution.

A complete description of ATL's CAR system can be found in ATL's SOP #61.

3.9 DOCUMENTING RESULTS OF QA ASSESSMENTS

Results of the previously mentioned QA assessments are documented in a **Quarterly QA Report** which summarize the status of any outstanding CARs, results from any PE samples, internal and external audit findings, and any general QA issues. This report is distributed to all directors, managers, and team leaders, and is made available to clients and auditors upon request. In addition, the following task-specific reports are produced.

- The 10% QA data review efforts are produced and tracked per analyst and per work order (*see ATL SOP #22*).
- The CAR system is summarized on a monthly basis (*see ATL SOP #61*).
- Items discussed in the QA/Team Leader meetings are summarized weekly.
- Internal audit findings are noted in the audit check lists (*see ATL SOP #27*).

EXHIBIT 3.1 - EXAMPLE PROJECT PROFILE

Project Name EPA Region I RAC DAS	Project Number REG1EPA-98-XXXX	P.O.# (If applicable)
---	--	----------------------------------

Report to Address	Bill To Address
--------------------------	------------------------

Name: John Brown Company: Brown Environmental P.O. Box: Street: 55 Broad Street City: Boston State/Zip: MA 01887 Phone/Fax: 508-555-3344	Client Services: JES Project ID: 1302
---	--

Analysis(es):	Reporting Method(s):
----------------------	-----------------------------

TO-14 \$250 RAC DAS-put in red
 20 TICS \$50
 Meth 3810 \$90 7 day hold time
 10 days for fax data; hardcopy CLP in 21 days

QC: 10 % Duplicate	10 % Method Spikes	100 % Lab Blanks	Special QC? <input checked="" type="radio"/> Yes <input type="radio"/> No
---------------------------	--------------------	------------------	--

Standard TAT? <input type="radio"/> Yes <input checked="" type="radio"/> No Uses P.O.#? <input type="radio"/> Yes <input checked="" type="radio"/> No Uses Project#? <input checked="" type="radio"/> Yes <input type="radio"/> Not Needed	CLP? <input checked="" type="radio"/> Yes <input type="radio"/> No Data Validatable? <input type="radio"/> Yes <input checked="" type="radio"/> No Diskette? <input checked="" type="radio"/> Yes <input type="radio"/> No CLP Narrative? <input checked="" type="radio"/> Yes <input type="radio"/> No	Fax to Other(s)? <input type="radio"/> Yes <input checked="" type="radio"/> No Final to Other(s)? <input type="radio"/> Yes <input checked="" type="radio"/> No Charge for shipping? <input checked="" type="radio"/> Yes <input type="radio"/> No Twelve Hour Clock? <input checked="" type="radio"/> Yes <input type="radio"/> No
---	--	--

Special Instructions

INLET AND OUTLET - WARNING - INLET SAMPLES MAY BE HIGH CONCENTRATION (will be marked)

Log-In
 SDG's required - 20 samples or less; 1 lab dup & 1 MS/MSD per SDG
 HT - 7 day non-preserved (CO₂), 14 day preserved (CH₄ & ethane), unless they effervesce - see COC
 If cooler temp is >6deg C, notify client immediately to obtain direction on whether or not to proceed.

Analytical Spec's
 ICAL RSD criteria is < or = 30% CCV %D criteria is < or = 30%
 Daily second source LCS required. %R criteria 70 - 130%.
 One lab dup per SDG required. %D (NOT RPD) criteria is < or = 30% for detections of 5.0 mg/L or greater, and < or = 50% for detections less than 5.0 mg/L.
 Target compound detections in blank must be < half of RL.

Reporting
 35 day TAT - Include one copy of the invoice with the analytical data package.
 CLP forms including: all QC (CCV, LCS, MS/MSD, blank, etc.), example calculations for positive detections, summary of RT windows per compound, copies of all communication, COCs, and a complete narrative.
 Each SDG must be custody-sealed, and include a "Completeness Evidence Audit Form"

EXHIBIT 3.2 - LABORATORY TRAINING RECORD

EMPLOYEE: _____ METHOD: _____

The normal training program consists of three developmental stages. Indicate the dates completed next to each stage. You should always progress from one stage to the next in sequential order. Training is complete when this form along with associated precision data is submitted to the Quality Assurance Group.

STAGE I. Introduction

Initial instruction is provided by the team leader or a more experienced analyst concerning the basic elements of the method and a brief overview of the instrumentation. Activities include, reading the applicable SOP(s), reading the reference method and loading samples. During this period of time, the trainee is an observer. Generally this period is brief.

Date Completed: _____ Trainer: _____

STAGE II. Training

This is a period of close contact with and one-on-one training by the team leader or a more experienced analyst. Activities include, performing Initial and Continuing Calibrations, routine maintenance and data reporting. During this time, which may last for several weeks, the analyst performs tasks independently as assigned but with all aspects of his/her work reviewed by the trainer.

Date Completed: _____ Trainer: _____

Stage III. Advanced Operation

During this period the analyst operates completely independently with his/her work passed into the normal laboratory review cycle. Activities include those listed in Stage II above, but the trainee acts independently. Completion of this stage is accomplished when four replicate standards are analyzed and meet the method accuracy and precision objectives. (Attach supportive quantitation page and/or summary).

EMPLOYEE: _____

DATE: _____

LABORATORY MANAGER: _____

DATE: _____

QUALITY ASSURANCE: _____

DATE: _____

EXHIBIT 3.3 - LABORATORY TRAINING RECORD REVIEW CHECK SHEET

Employee: _____

Items Present

- 1 ☐ Resume
- 2 ☐ Documentation of Reading the Quality Manual
- 3 ☐ Yellow Training Record
- 4 ☐ Documentation of Reading SOP
- 5 ☐ Documentation of Reading Method
- 6 ☐ Proficiency Data
- 7 ☐ Documentation of Classes/Continuing Education Courses

Filling Out Yellow Training Record

- 8 ☐ Each Stage has "Date Completed" and "Trainer" Completed
- 9 ☐ Employee Signed
- 10 ☐ Lab Manager Signed
- 11 ☐ Quality Assurance Signed

Initial Proficiency Data

- 12 ☐ Four Replicate CCVs, either Analyzed on the Same Day or on Four Separate Days, or an Initial Curve with Second Source Check
- 13 ☐ Meets Method Criteria for Accuracy and Precision
- 14 ☐ Date and Initials of Review on Proficiency Data

Continued Data Proficiency

- 15 ☐ Four Replicate CCVs, either Analyzed on the Same Day or on Four Separate Days, an Initial Curve with Second Source Check, an MDL study, or a PE sample.
- 16 ☐ Performed within a Year or Less
- 17 ☐ Meets Method Criteria for Accuracy and Precision
- 18 ☐ Date and Initials of Review on Proficiency Data

Comments: (notation of missing items, incorrectly completed forms, etc.)

Reviewed By

Date

EXHIBIT 3.4 – INTERNAL TRAINING COURSES

Gas Chromatography
Column Selection, Care & Maintenance
Detectors - Overview of Team A & B
The mass spec detector - specific training
GC Parameters
Injection Techniques
Proper Use of Fittings and Gas Traps
Quality Assurance
Introduction to QA and Lab Nomenclature
Quality Manual, Client QAPS - What to use?
How to use CARs
How to use SOPs
How to write and update SOPs
Control Charts - what good are they?
Calibration and Analysis
Standards Preparation and Documentation
Syringe & Dilution Techniques
Proper Log Book Protocol
Canister Pressurization
Correct Operation of Manual Interface
NOAH - Overview
The ATL Way
Bidding through Invoicing, the Process
Training Records - How to set up & maintain
Health & Safety Training
On the Job Team Specific courses
Detectors - Specific Training (PID/FID, ECD)
THC, TPH, NMOC, and all that
AFCEE 3.0 Criteria
EDD Production
Understanding Analysis of Atmospheric Gases
Understanding Analysis by TO-3
Understanding Analysis by TO-13/8270
Overview of Sulfur Analysis & the SCD
Overview of Remaining Team B Methods
Understanding Analysis by TO-14/15
Understanding VOST Analysis

EXHIBIT 3.5

Laboratory Corrective Action Request

No. _____

QA/QC must receive Corrective Action Form within 24 hours of being initiated.

Initiated By: _____ Date: _____ Given To: _____

Sections I - IV must be filled out by the person initiating this corrective action request.

Received By: _____ Date: _____ Given To: _____

Extractions or lab personnel

Team Leader: _____ Date: _____ Given To: _____

Verify Sections I - IV were filled out correctly

Client Service: _____ Date: _____ Given To: _____

Sections V must be filled out by client services personnel.

QA/QC: _____ Date: _____ Given To: _____

I. Method(s) affected: _____

Work order(s) affected: _____

Sample(s) affected: _____

Client(s) sample ID: _____

Client(s) affected: _____

Client Service Contact: _____

Data Validation Package? Y N CLP Narrative? Y N

II. Nonconformities:

- ☐ Holding Time Exceeded.
- ☐ Initial Calibration or 2nd source check curve is outside of acceptance criteria.
- ☐ CCV, mid-day or end-check is outside of acceptance criteria.
- ☐ Internal standard area(s) or RT is outside of acceptance criteria.
- ☐ Surrogate recoveries are outside of acceptance criteria.
- ☐ Method Blank contains a target compound(s) that is above the detection limit.
- ☐ LCS or matrix spike recoveries are outside of acceptance criteria.
- ☐ Duplicate analysis precision is outside of acceptance criteria.
- ☐ Problem w/sample container (leakage, breakage) prevented analysis.
- ☐ Malfunction to instrument/interface/Tekmar resulted in sample loss.
- ☐ Sample lost during extraction procedures.
- ☐ Other

III. Describe the nonconformity and its cause.

(continued)

EXHIBIT 3.5 (continued)

IV. Describe the corrective actions initially attempted to resolve this issue.

To be filled out by Client Services or QA Department Representative Only

V. Client Notification:

Person notified: _____ Notified by: _____ Date: _____

Client Instructions:

To be filled out by QA Department Representative Only

VI. Additional Recommended Corrective Action:

Date Implemented: _____

VII. Follow up Action Necessary? Y N

Describe follow-up action.

Date Follow up Action Completed: _____

QA Department Closure Date: _____

QA Department Signature: _____

4.0 QUALITY OBJECTIVES

The primary objective of the Quality Assurance Program is to ensure the laboratory is producing data which meet the laboratory's standard acceptance criteria for each method. Acceptance criteria from project-specific QAPPs are also used when required.

The laboratory's standard acceptance criteria and the sources of those criteria are specified in Section 6.0 of this Quality Manual. Definitions of parameters used to assess the quality of the data are defined below.

4.1 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY

4.1.1 Precision

Precision measures the reproducibility of measurements. *Analytical* precision is the agreement among duplicate (two) or replicate (more than two) analyses of the same sample. The acceptance for precision is determined using the relative percent difference (RPD) between the duplicate sample results. For replicate analyses, the relative standard deviation (RSD) is determined. The formulae for the RPD and RSD calculations are provided in Exhibit 4.1.

Field duplicate samples represent *total* precision, the reproducibility associated with the entire sampling and analysis process. However, the identification of field duplicate samples are typically not known to the laboratory, and therefore not specifically

evaluated by the laboratory's QA department.

4.1.2 Accuracy

Accuracy measures correctness and includes components of random error (variability due to imprecision) and systemic error. Analytical accuracy is measured by comparing the percent recovery of analytes spiked (as compared to the expected value) to pre-established accuracy limits (i.e., acceptance criteria). Any type of spiked sample measures accuracy. The formula for calculation of accuracy is included in Exhibit 4.1 as percent recovery (%R) from pure and sample matrices.

4.1.3 Representativeness

Representativeness is achieved through use of the standard analytical procedures described in this Quality Manual.

4.1.4 Completeness

Completeness is the percentage of data which meets the established acceptance criteria referenced in Section 4.0. This laboratory's goal is to achieve at least a 95% completeness for both normal turn-around-time (TAT) and rush TAT data. Meeting the method specification outlined in each SOP prior to analyzing project samples is our means of achieving this goal.

4.1.5 Comparability

Comparability is the confidence with which one data set can be compared to another. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. Comparability is achieved by using standard analytical methods, reporting data in standard units, and using standard and comprehensive reporting formats.

4.2 MINIMUM DETECTION LIMITS, REPORTED DETECTION LIMITS, AND INSTRUMENT CALIBRATION REQUIREMENTS

4.2.1 Minimum Detection Limits

The minimum detection limit (MDL) is a statistically determined value. If the true concentration is below this value, the analyte will not be detected. This can be stated with a 99 percent confidence level, according to the protocol established in 40 CFR. MDLs are established for each method, matrix, and analyte for each instrument, using the procedures noted in 40 CFR Pt. 136 Appendix A. The MDL study is repeated at least once per twelve month period.

4.2.2 Reported Detection Limits

Because the MDL is a statistically derived value which is not validated by any recovery studies, and because the values are specific to each instrument, ATL reports down to a "reported" detection limit.

The detection limit represents a uniform value that can be accurately detected for any particular analyte on each of our instruments, thereby providing consistency for samples analyzed on different instruments. The detection limits are verified both by a statistical MDL study and a detection-limit level recovery study. The detection-limit level recovery study is performed each time an instrument is calibrated.

The acceptance criterion for the MDL study is for a value of less than or equal to the detection limit. The acceptance criterion for the recovery study is generally 50% - 150% though in-house limits will be put into use once enough data has been collected. (Expected date for implementing the use of in-house limits for the detection-limit level recovery study is June 2000.) Corrective action up to and including raising the detection limit is performed if either the statistically determined MDL or recovery study results do not meet the stated criteria.

4.2.3 Instrument Calibration

Analytical instruments are calibrated in accordance with the referenced analytical methods. The acceptance criteria are summarized in Section 6.0. All specific target analytes are included in the initial and continuing calibrations.

If multi-point calibrations do not meet acceptance criteria stated in the relevant SOPs, an option to narrow the range of the curve either by eliminating the low point or the high point of the curve can be considered providing all project criteria are still met. Otherwise, the entire calibration curve is repeated. Elimination of any of the inner levels of the multi-point calibration in order to meet QC acceptance criteria is not allowed.

Records of instrument calibration and records that unambiguously trace the preparation of standards and their use in instrument calibration are maintained for a minimum of ten years. Calibration standards are traceable to standard materials.

An independently-prepared standard containing all target compounds noted in the Section 6.0 tables is analyzed after each initial curve, to verify that the standards are correct and the calibration is accurate. The acceptance criteria for the independent source recoveries are presented in Section 6.0.

Analyte concentrations are determined primarily using the average RF from the initial multi-point calibration.

4.2.4 Retention Time Window

The techniques used to establish retention time windows for GC and HPLC analyses vary by method based on the class of compounds targeted, as well as the instrument specifications (column type, etc.). Protocol for establishing retention time windows can be found in the method-specific SOPs.

4.3 ELEMENTS OF QUALITY CONTROL

The various types of QC samples are described below. The method specific laboratory QC sample frequency and acceptance criteria can be found in Section 6.0.

4.3.1 Analytical Batch Definition

Samples analyzed during a single 24-hour period along with associated matrix specific laboratory QC samples make up an analytical batch. At a minimum any analytical batch would include a method blank and continuing calibration verification, and for non-GC/MS methods, an end check. Reporting of the batch QC samples varies according to project requirements. The number of field samples included in any one analytical batch does not exceed 20 when required by specific projects.

4.3.2 Continuing Calibration Verification (CCV)

A continuing calibration verification (CCV) containing all analytes of concern is performed at the start of each day and, if required, at the start of every 12 hours. The CCV is an analysis of the primary source mid-level calibration standard. If the CCV fails to meet the performance criteria then maintenance should be performed and the test repeated. If the system still fails the calibration verification, a new multi-point calibration curve is performed.

4.3.3 Laboratory Control Spike (LCS)

For extractable methods, and for non-extractable methods when required for specific projects, a mid level spike using an independent source standard containing a subset of target analytes is analyzed daily prior to sample analysis. If the stated criteria are not met, the system is checked and the standard re-analyzed. In the event that the criteria cannot be met, the instrument is re-calibrated.

4.3.4 Internal Standard (IS)

For GC/MS methods, an IS blend is introduced as each standard, blank, and sample is being loaded onto the instrument to monitor the stability of the analytical system. The internal standard acceptance criteria vary by method, though for all applicable analyses at ATL, if the internal standards for the blank do not pass the acceptance criteria, the system is inspected and the blank reanalyzed. Analyses do not continue until the blank meets the internal standard criteria.

4.3.5 Surrogates

For GC/MS methods, and some GC methods, a surrogate blend is introduced as each standard, blank, and sample is being loaded onto the instrument to monitor the stability of the analytical system. The surrogate recovery acceptance criteria vary by method, though for all applicable analyses at ATL, if the surrogate recoveries for the blank do not pass the acceptance criteria, the system is inspected and the blank reanalyzed. Analyses do not continue until the blank meets the surrogate recovery criteria.

If the surrogate recoveries for a sample are outside of these limits, the sample is reanalyzed unless obvious matrix interference is documented. If the surrogate recoveries are within limits in the re-analysis, the second analysis will be reported. If the surrogate recoveries are out of limits a second time, the sample will be reported with a narrative indicating the acceptance criteria for surrogate recoveries were exceeded. Upon request, the data from the matrix effect confirmation analysis is provided to the client.

4.3.6 Laboratory Blank

A laboratory blank is analyzed after any applicable standards and prior to the analysis of project samples. A blank is also analyzed in the event saturation-level concentrations are incurred to demonstrate that contamination does not exist.

The acceptance criterion for laboratory blanks is a result less than the detection limit. For projects that require MDL-level reporting, the acceptance criteria for laboratory blanks can include taking corrective action for detections as low as the instrument-specific MDL but need to be specified during the project set-up stage.

For methods which involve an extraction, a method blank is extracted with each set of up to 20 extracted samples and is analyzed immediately after the calibration standard to ensure both the instrument and extraction process are free from contamination. When samples that are extracted together are analyzed on different analytical shifts, a solvent (instrument) blank is analyzed to demonstrate that the instrument is free from contamination.

4.3.7 Laboratory Duplicate

Project samples are analyzed in duplicate on a minimum of 5% of the samples received. For some projects, the required frequency is

10%. The acceptance criteria for analytical reproducibility generally apply to analytes present at 5 times the detection limit and greater. If the noted criteria is exceeded, the sample is re-analyzed a third time. If acceptable reproducibility is still not obtained, the cause is investigated and the system brought back to working order. If no problem is found on the system, the data is flagged to note the non-conforming event.

4.3.8 Matrix Spikes

Matrix spiking would permanently alter the native concentrations of whole air samples, and therefore, matrix spiking is performed only on samples such as condensates submitted as part of a sampling train. When applicable, matrix and matrix duplicate spiking is performed using a subset of target analytes. Recoveries and demonstrated reproducibility values which do not meet the acceptance criteria are Q flagged and explained in the laboratory narrative.

4.3.9 Field QC Samples

Field blanks, field spikes and field duplicates are generally treated as normal project samples by the laboratory. The exceptions include methods in which the sample media is specifically prepared by the laboratory at the direction of the client.

4.4 QUALITY CONTROL PROCEDURES

4.4.1 Holding Times

All sample preparation and analysis shall be completed within the method-required holding times. The analytical holding time for a non-extractable method begins the day of sample collection. For extractable methods, the holding time is calculated from the day of sample collection for the extraction process, and from the day the extraction process begins for the analytical process.

If holding times are exceeded, a CAR (see Section 3.8) form is generated, the client is notified, and situation is narrated on the final report.

4.4.2 Confirmation

Quantitative confirmation is generally not performed for air sample analysis. The exception is for analysis of PCBs and pesticides by SW-846 methodology, in which case, second column confirmation is completed within the method-required holding times.

4.4.3 Standard Materials

Each analytical instrument is calibrated using standard materials traceable to National Institute Standards and Technology (NIST).

Independently prepared standards are used to confirm the accuracy of primary source calibration standards. The independently

prepared standards are from the same vendor, but a different lot number due to the difficulty of obtaining accurate standards for air analysis. The independently prepared standards are used for the laboratory control samples as well.

4.4.3.1 Liquid standards are prepared by dilution from commercial sources. Stock solutions are purchased and stored in a separate refrigerator/freezer. Dilutions to working ranges are prepared using high purity solvents. Solvents are dated upon arrival and stored in a vented, flammables cabinet.

4.4.3.2 Gas standards are purchased from a commercial supplier and stored in vendor recommended cylinders using high purity regulators. Standards that are not available in certified blends from commercial suppliers are purchased in neat form. Neat materials are purchased with a purity of at least 96%.

Certified gas blends are purchased at PPM levels and diluted into the working range using a laboratory fabricated dilution manifold detailed in EPA Method TO-14. High purity flow controllers and flow sensors are used to monitor the calibration gas and diluent flow rates during the blending process. Neat standards are prepared by static dilution using syringe injection of the neat material into the calibrated contents of a Tedlar bag.

Concentration of the blend is determined using density based calculation:

$$\text{PPBV} = \frac{\text{nG/MW}}{\text{vol(L)}/24.055^*}$$

* 24.055 is the molar volume of any gas at standard pressure (1 atmosphere) and standard temperature (20°C), derived from the ideal gas law ($PV_m = nRT$), where R = the universal gas constant.

Once blended, the standard is transferred into a Summa canister for long term storage and stability.

The preparation of working standards, either gaseous or liquid, are documented in bound standard preparation log books. Each page is signed and dated by the analyst and each standard is given a unique identification number. Additional information including the solvent or standard lot number and stock standard concentration is noted.

4.4.4 Expiration Dates of Standards

4.4.4.1 Primary standards expire according to the manufacturer's expiration date. If an expiration date is not assigned by the manufacturer, a period of one year is applied. Expiration dates are noted on standard labels. Expired standard materials are either revalidated by comparison with unexpired independently prepared standards, or are discarded. The acceptance criteria for

standards revalidation is the same as the accuracy limits noted in the tables in Section 6.0. The newer of the two standards is always used as the primary source.

Expiration dates for laboratory-prepared stock and diluted standards shall be no later than the expiration date of the stock solution or material.

All efforts are made to obtain the highest purity possible when purchasing neat chemical standards. The vast majority of neat standards are $\geq 96\%$ pure. Standards purchased at less than 96% purity are documented as to why a higher purity could not be obtained and are corrected for impurity.

Neat liquid standards are used until analysis by GC/FID indicates a purity of less than 96% (or less than the stated purity for the exceptions). The date of the purity check is noted on the neat standard vial.

The procedure for verifying the purity of neat standards commenced in May of 1999. Approximately 10 standards are analyzed per week.

4.4.4.2 Secondary Standards are assigned based on the expiration date of the primary source standard (i.e., no later than), the compounds present and container type. Typical Expiration dates are presented in Exhibit 4.2.

EXHIBIT 4.1 STATISTICAL CALCULATIONS

Statistic	Symbol	Formula	Definition	Uses
Mean	\bar{X}	$\frac{\sum_{i=1}^n x_i}{n}$	Measure of central tendency	Used to determine average value of measurements
Standard Deviation	S	$\left(\frac{\sum (x_i - \bar{X})^2}{(n-1)} \right)^{1/2}$	Measure of relative scatter of the data	Used in calculating variation of measurements
Relative Standard Deviation	RSD	$(S / \bar{X}) \times 100$	Relative standard deviation, adjusts for magnitude of observations	Used to assess precision for replicate results
Percent Difference	%D	$\frac{x_1 - x_2}{x_1} \times 100$	Measure of the difference of 2 observations	Used to assess accuracy
Relative Percent Difference	RPD	$\left(\frac{(x_1 - x_2)}{(x_1 + x_2) / 2} \right) \times 100$	Measure of variability that adjusts for the magnitude of observations	Used to assess total and analytical precision of duplicate measurements
Percent Recovery	%R	$\left(\frac{x_{\text{meas}}}{x_{\text{true}}} \right) \times 100$	Recovery of spiked compound in pure matrix	Used to assess accuracy
Percent Recovery	%R	$\frac{\left(\frac{\text{value of spiked sample} - \text{value of unspiked sample}}{\text{Value of added spike}} \right)}{\text{Value of added spike}} \times 100$	Recovery of spiked compound in sample matrix	Used to assess matrix effects and total precision
Correlation Coefficient	r	see SW8000B section 7.5.3		Evaluation of "goodness of fit" of a regression line

x = Observation (concentration)

n = Number of observations

EXHIBIT 4.2

Gas Standards Prepared from Certified Cylinders

<u>Compounds</u>	<u>Tedlar Bag Standard</u>	<u>Summa™ Canister</u>
TO-14 List of 41 compounds	3 days	3 months
BTEX/TPH	3 days	6 months
Sulfur Compounds	2 days	NA

Gas Standards Prepared from Neat Materials

<u>Compounds</u>	<u>Tedlar Bag Standard</u>	<u>Summa™ Canister</u>
TO-14 Extra Compounds	3 days	6 months
Other Compounds	3 days	6 months

Liquid Manufacturer's Certified Mix and Single Component Standards

The manufacturer's expiration date is used when indicated. If none is supplied, the following expiration dates are applied:

<u>Compound</u>	<u>Expiration</u>
Gases in Liquid	1 month after opening ampule
Other Volatile compounds	6 months after opening ampule
Semivolatile/Pesticides/PCBs	1 year after opening ampule

Liquid Stock Standards Prepared from Neat Materials

<u>Compound</u>	<u>Expiration</u>
Gases in Liquid	1 month
Other Volatile Compounds	6 months
Semivolatile/Pesticides/PCBs	1 year

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5.0 SAMPLE HANDLING

5.1 SAMPLING MEDIA AND PRESERVATION REQUIREMENTS

As a contract analytical laboratory, ATL is not directly involved with field sampling and the quality control associated with it. The laboratory does assist in monitoring aspects of sample handling such as shipping requirements and analytical holding times.

Sampling media, preservation, and holding time requirements are summarized in Exhibit 5.1.

Disclaimer: ATL assumes no real or implied responsibility or liability for client-related field sampling activities. It is the responsibility of the individual client to ensure that referenced methodologies are followed with respect to sample collection and shipment to the laboratory.

5.1.1 Sample Containers

Media provided by the laboratory include:

- Sampling media such as desorbed and certified Tenax and charcoal traps, "Summa" polished canisters, Silcosteel® canisters, Tedlar bags, PUF/XAD and DNPH
- Chain of custody forms
- Sampling labels
- Chemical ice packs
- Shipping containers
- Custody Seals

Summa canisters and sorbent tubes prepared by the laboratory for sampling must be certified for cleanliness. Each batch is certified by blank analysis as follows.

5.1.1.1 Summa Canisters

Ten percent of the canisters cleaned are certified by GC/MS analysis for TO-14 target compounds.

Criteria for passing certification are as follows. Six liter canisters are certified to be clean to 0.2 ppbv for standard TO-14 target compounds and 0.8 ppbv for polar and non-standard TO-14 compounds. The certification levels for 1 liter canisters are 2.0 ppbv and 8.0 ppbv.

If a canister fails certification, that canister and the other two canisters in the batch will be evacuated, re-cleaned, and then re-certified.

For projects that require low level or SIM analysis, ATL recommends that clients request (through the ATL project manager) an additional level of certification during the project set-up stage. This additional level should include certification down to the required detection levels. An increase in the percent of canisters certified is also recommended for projects of a very sensitive nature.

Each ATL canister is bar coded, allowing the history of each canister to be maintained through a canister tracking system.

5.1.1.2 Sorbent Tubes

Each batch of sorbent tubes is certified using the VOST/5041A methodology. Tubes from the sampling batch are separated from the field tubes prior to shipping and stored in a $4\pm 2^{\circ}\text{C}$ refrigerator to be analyzed by GC/MS. The background level of each target VOC must be less than 10 nG except for common laboratory solvents such as methylene chloride and toluene. Tube certifications are reported when the client is billed for the tube preparation. This report is separate from the field sample report.

5.1.2 Preservation Requirements

Preservation requirements for the analytical methods performed by ATL are listed in Exhibit 5.1.

5.2 SAMPLE COLLECTION PROCEDURES - FIELD GUIDELINES

The information provided in this section is meant to serve only as a general guideline. In all cases, field sampling personnel are ultimately responsible for having expertise and knowledge in air sampling methodology sufficient to ensure that the defensibility of the data will not be compromised due to deficiencies in field sampling, collection activities, sample collection or transportation.

5.2.1 Information for Canister Sampling

- Always use a filter when sampling. Never allow liquids (including water) or corrosive vapors to enter the canister.
- Do not attach labels to the surface of a canister.

- Canisters require gentle shut off of the inlet valves. (CAUTION - DO NOT OVER TIGHTEN THE NUPRO VALVES OR AIR LEAKS MAY RESULT). Remember to use a brass plug after sampling.
- Clients will be held liable for damaged canisters.

5.2.2 Information for Sorbent Tube and Impinger Sampling

- When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during collection and transportation.
- Ice chests should be fully packed in order to avoid sample breakage due to unnecessary movement. Use the minimum size ice chest and pack any unused portions with filler.
- A temperature blank (a volatile organics compounds sampling vial filled with tap water) should be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory.

5.2.3 Chain-of-Custody (COC) Documentation for Shipping

- Enclose a completed and signed COC form with the sample shipment. The chain of custody form (Exhibit 5.2) tracks each sample from point of collection to arrival at the laboratory. For multiple-box shipments, it is best to place a copy of the COC in each sample box.
- Affix a tamper evident, signed and dated custody seal to the shipping container.

5.3 SAMPLE RECEIVING PROCEDURES

Upon arrival at the laboratory samples are inspected for the following items:

- physical damage
- integrity of the custody seal
- number of samples
- sample collection date
- missing chain of custody form
- incomplete or incorrectly completed chain of custody form
- sample tag information
- temperature (when applicable)
- pressure (canisters)

Any discrepancies found with the samples are documented on the Sample Discrepancy form (Exhibit 5.3), and communicated to the client via facsimile within 1 day of sample receipt. Alternatively, the client is typically contacted by phone for a discrepancy of a serious nature.

Malfunctions that occur during/after sample receipt are documented via the Corrective Action Report using the procedures described in section 3.8. Shipping air bills, packing lists, chain of custody records and any other documentation that may accompany the samples are placed in project files.

5.4 SAMPLE TRACKING PROCEDURES

After samples have been inspected, they are given a unique tracking number and logged into the receiving database. In addition, canisters are scanned into the canister asset tracking database.

- The tracking number consists of the year and month plus a sequential work order number. As an example, the first set of samples received in July, 1999 would have the format, **9907001**.
- If this set of samples consisted of eight individual samples, then each sample is identified by a consecutive post script such as, **9907001-01A.....08A**
- If more than one analysis is requested for the samples, an alphabetic designation is given to each analysis sample set,
TO-15: **9907001A-01A...08A**
TO-3: **9907001B-01A...08A**
ASTM 1946: **9907001C-01A...08A**
- Laboratory assigned duplicates are designated using a double post script such as, **9907001-01AA**.

5.5 INTERNAL SAMPLE CUSTODY AND STORAGE PROCEDURES

Once received at the laboratory, the chain of custody of samples is documented from time of receipt until time of disposal. Internal sample chain-of-custody documentation consists of:

- Internal Sample Tracking Log Book
- Instrument run logs
- Raw analytical data for samples, calibrations and QC checks
- Refrigerator & canister log books

The samples are stored either in a secure 4° +/- 2°C refrigerator or in the canister holding area. The receiving personnel enters the samples into the Internal Sample or Extractable Sample Tracking Log in the storage area. Samples are tracked in/out of the limited access area in an Internal Sample Tracking Log.

5.6 SAMPLE DISPOSAL

Samples are released for disposal upon satisfactory completion of analysis unless prior contractual arrangements have been made. The release of samples is documented in the Internal Sample Tracking Log via a "Released" stamp that includes the date and initials of the person who released the sample for disposal.

Samples are released by the Analytical Team Leaders, or an assigned designee.

Sample disposal varies based on the sampling media. Whole air samples are vented through a charcoal scrubber, and liquid (i.e., solvent and water) samples are disposed of according to the procedures noted in ATL's Chemical Hygiene Plan.

EXHIBIT 5.1
Requirements for Containers, Preservation Techniques, and Holding Times

Method	Parameter	Type	Container	Preservation	Extraction Holding Time -	Analytical Holding Time
VOST 5041	VOCs	GC/MS	Sorbent Tube	4°C	NA	14 days
TO-3 & CARB 410A	BTEX/TPH	GC/FID/PID	Summa Canister	NA	NA	30 days
			Tedlar Bag	NA	NA	3 days
TO-4 & TO-10	Pesticides PCBs	GC/ECD	PUF	4°C	7 days	40 days
TO-5 & CARB 430	Aldehydes & Ketones	HPLC	DNPH Impinger	4°C	7 days	30 days
TO-6	Phosgene	HPLC	Aniline Impinger	4°C	7 days	30 days
TO-8	Phenols	HPLC	NaOH Impinger	4°C	2 days	30 days
TO-11	Aldehydes & Ketones	HPLC	Sep-PAK	4°C	30 days	30 days
TO-12	NMOC	GC/FID	Summa Canister	NA	NA	30 days
			Tedlar Bag	NA	NA	3 days
TO-13/ 8270	PAHs/ Semivolatiles	GC/MS	XAD/PUF	4°C	7 days	40 days
TO-14	VOCs	GC/MS	Summa Canister	NA	NA	30 days
			Tedlar Bag			3 days
TO-17	VOCs	GC/MS	Sorbent Tube	4°C	NA	30 days
ASTM D1946	Fixed Gases CH ₄ , C ₂ +	GC/TCD/FID	Tedlar Bag	NA	NA	3 days
			Summa Canister			30 days
ASTM D1945	Fixed & Natural Gases	GC/TCD/FID	Tedlar Bag	NA	NA	3 days
			Summa Canister			30 days
ASTM D5504	Sulfur Gases	GC/SCD	Tedlar Bag	NA	NA	1 day
			"Doped" Tedlar Bag		NA	3 days
			SilcoCan™		NA	3 days
BIF0011	Aldehydes & Ketones	HPLC	DNPH Impinger	4°C	7 days	30 days
EPA Method 18	VOCs	GC/ECD/PID	Summa Canister	NA	NA	30 days
			Tedlar Bag			3 days
EPA Meth. 25C/3C	Fixed Gases & NMOC	GC/TCD/FID	Summa Canister (6 liter)	NA	NA	30 days
Headspace Analysis	Dissolved Gases	GC/FID	40 ml VOA vials	4°C & 1:1 HCl, pH<2	NA	14 days
	CO ₂			4°C & NO HCl	NA	7 days



AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

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CHAIN-OF-CUSTODY RECORD

Page ____ of ____

Contact Person _____ Company _____ Address _____ City _____ State _____ Zip _____ Phone _____ FAX _____ Collected By: Signature _____			Project Info: P.O. # _____ Project # _____ Project Name _____		Turn Around Time: <input type="checkbox"/> Normal (for standard report) <input type="checkbox"/> Rush _____ Specify _____	
Lab I.D.	Field Sample I.D.	Date & Time	Analyses Requested	Canister Pressure / Vacuum		
				Initial	Final	Receipt
Relinquished By: (Signature) Date/Time		Received By: (Signature) Date/Time		Notes:		
Relinquished By: (Signature) Date/Time		Received By: (Signature) Date/Time				
Relinquished By: (Signature) Date/Time		Received By: (Signature) Date/Time				
Lab Use Only	Shipper Name		Air Bill #	Temp. (°C)	Custody Seals Intact?	Work Order #
	FED-X Other	UPS US Postal			Yes No None N/A	

Form 1293 rev. 07

EXHIBIT 5.2 - CHAIN-OF-CUSTODY

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EXHIBIT 5.3 - Sample Receipt Discrepancy Report

Initiated By: _____ Date: _____ Given To: _____
Sections I - III must be filled out by the person initiating this sample discrepancy report.

I. Work order affected: _____

Sample(s) affected: _____

II. Discrepancies:

To be noted in Log-in FAX

- ☐ Chain of Custody Record (COC) improperly relinquished.
- ☐ COC was not filled out in ink.
- ☐ Number of samples on the COC do not match the number of samples that were received.
- ☐ Sampling date is not documented.
- ☐ Sample tags do not match the COC.
- ☐ Samples received at wrong temperature.
- ☐ Canister sample received at >15"Hg.
- ☐ Sample container (Tube/VOA vial) was received broken, however, sample was intact.
- ☐ Other

To be noted by Client Services Call

- ☐ Custody seal on the outside of the container was broken.
- ☐ Chain of Custody Record (COC) was not received with sample(s).
- ☐ Analysis method(s) is not specified on the COC.
- ☐ Sample(s) received out of holding time.
- ☐ Flow controller used - canister samples received at <2.5"Hg.
- ☐ Sample container (Tube/VOA vial) was received broken.
- ☐ Container for VOA analysis received with headspace.
- ☐ Tedlar Bag received leaking.
- ☐ Tedlar Bag received flat.
- ☐ Canister received with a leaky valve.
- ☐ Tedlar bag / canister received emitting a strong odor (sample cannot be analyzed).
- ☐ Initial laboratory Vac./Press. does not match final field pressure.
- ☐ Other

(continued)

Sample Receipt Discrepancy Report (continued)

III. Describe the discrepancy.

IV. Client Notification:

Person notified: _____ Verbally by: _____ Date: _____

Person notified: _____ Login fax by: _____ Date: _____

Client Instructions:

Client Services representative to check one of the following:

At Log-in, include this information on the: ☐ LOG-IN FAX
☐ Report Narrative

6.0 ANALYTICAL METHODS AND PROCEDURES

This section contains subsections for each analytical procedure. Each subsection contains the following information:

- A brief method description
- A table of DLs and QC acceptance criteria
- A table of calibration procedures and QC procedures

The following documents were used as guidance for the information presented in this section:

- **EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air (First and Second Editions)**
- **EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air**
- **Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Final Update III, Revision 1, December, 1996**
- **Statement of Work for the Organic Superfund Contract Laboratory Program 10/86**
- **CLP Draft - Analytical Method for the Determination of VOCs in Air Collected in Summa Canisters and Analyzed by GC/MS - December 1991**

- **Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act 40 CFR (136) 1984**
- **NIOSH Manual of Analytical Methods**
- **Annual Book of ASTM Standards**
- **OSHA Analytical Methods Manual**
- **California Air Resources Board Stationary Source Test Manual**

This Quality Manual references methods in a general manner. The specific revisions used by the laboratory can be found in the method-specific SOPs.

6.1 VOST SW-846 5041

This method involves GC/MS full scan analysis of volatile organic compounds in air samples collected on Tenax/Charcoal (VOST) cartridges. Samples are collected using Method 0030/0031 Volatile Organic Sampling Train (VOST) protocols. The VOST cartridges are thermally desorbed by heating and purging with organic-free helium. The resulting gaseous effluent is transferred to a purge and trap system containing 5 mls of boiled and purged reagent grade VOA free water and then on to a quadrupole for GC/MS analysis. The condensate samples are placed in the sparge vessel of the purge and trap (P&T) and analyzed in a similar manner.

ATL performs a modified version of this method. The modifications are detailed in the method specific SOP.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-1.1. SW-846 Modified Method 5041A (Standard List of Analytes)

Analytes	Detection Limit (ng)	Acceptance Criteria		
		ICAL (%RSD)	ISCV (% R)	CCV
1,1,1-Trichloroethane	10	15%	70-130	-
1,1,2,2-Tetrachloroethane - SPCC	10	30%	70-130	RF > 0.30
1,1,2-Trichloroethane	10	15%	70-130	-
1,1-Dichloroethane - SPCC	10	15%	70-130	RF > 0.10
1,1-Dichloroethene - CCC	10	30%	70-130	%D ≤ 25%
1,2,3-Trichloropropane*	10	30%	70-130	-
1,2-Dichloroethane	10	15%	70-130	-
1,2-Dichloropropane - CCC	10	30%	70-130	%D ≤ 25%
Acetone**	50	30%	50-150	-
Acrylonitrile*	10	15%	70-130	-
Benzene	10	15%	70-130	-
Bromodichloromethane	10	15%	70-130	-
Bromoform - SPCC	10	30%	70-130	RF > 0.10
Bromomethane**	10	30%	50-150	-
Carbon Disulfide**	10	15%	70-130	-
Carbon Tetrachloride	10	15%	70-130	-
Chlorobenzene - SPCC	10	15%	70-130	RF > 0.30
Chloroethane	10	15%	50-150	-
Chloroform - CCC	10	30%	70-130	%D ≤ 25%
Chloromethane - SPCC	10	30%	50-150	RF > 0.10
cis-1,3-Dichloropropene	10	15%	70-130	-
Dibromochloromethane	10	15%	70-130	-
Dibromomethane*	10	15%	70-130	-
Ethyl Benzene - CCC	10	30%	70-130	%D ≤ 25%
Freon 11* (Trichlorofluoromethane)	10	15%	70-130	-
Iodomethane*	10	15%	70-130	-
m,p-Xylene	10	15%	70-130	-
Methylene Chloride	10	15%	70-130	-
o-Xylene	10	15%	70-130	-
Styrene	10	15%	70-130	-
Tetrachloroethene	10	15%	70-130	-
Toluene - CCC	10	30%	70-130	%D ≤ 25%
trans-1,2-Dichloroethene	10	15%	70-130	-
trans-1,3-Dichloropropene	10	15%	70-130	-
Trichloroethene	10	15%	70-130	-
Vinyl Chloride - CCC	10	30%	50-150	%D ≤ 25%

* Independent source verification check not available for these compounds.

** Due to nature of compounds, recoveries outside of noted limits do not result in re-calibration.

Table 6-1.2. Analytes Spiked

Analyte	Matrix Spike		LCS***
	% Recovery	% RPD	% Recovery
1,1-Dichloroethene	50 - 150	35	40 - 159
Benzene	50 - 150	35	59 - 140
Chlorobenzene	50 - 150	35	57 - 152
Toluene	50 - 150	35	67 - 135
Trichloroethene	50 - 150	35	64 - 128

Table 6-1.3. Internal Standards

Analyte	CCV IS % Recovery	Sample IS % Recovery
1,4-Dichlorobenzene-d ₄	50 - 200	60 - 140
Chlorobenzene-d ₅	50 - 200	60 - 140
Fluorobenzene	50 - 200	60 - 140

Table 6-1.4. Surrogates***

Analyte	% Recovery
1,2-Dichloroethane-d ₄	69 - 137
4-Bromofluorobenzene	70 - 133
Dibromofluoromethane	72 - 135
Toluene-d ₈	77 - 124

*** The LCS and surrogate limits are in-house limits that are updated quarterly.

Table 6-1.5. Summary of Calibration and QC Procedures for SW-846 Modified Method 5041A

Note: These criteria is used specifically for the standard list of analytes listed in Table 6-1.1.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Prior to calibration and at the start of every 12-hour clock	Method 5041A tuning criteria	Correct problem then repeat tune
Initial 5-Point Calibration	Prior to Sample Analysis.	SPCC criteria in Table 6-1.1 CCC criteria in Table 6-1.1 non-CCC compound criteria in Table 6-1.1	Correct problem then repeat initial calibration
Independent Source Calibration Verification (ISCV)	Once per initial calibration	See Table 6-1.1	Investigate the problem and if warranted, analyze a new analytical curve for the out-of-limits compound (except for *compounds in Table 6-1.1)
Continuing Calibration Verification (CCV)	At the start of every shift immediately after the BFB tune check	For SPCCs: see "CCV criteria" column in Table 6-1.1 For CCCs: $\%D \leq 25\%$	Investigate and correct the problem, up to and including recalibration if necessary.
Laboratory Control Sample (LCS)	With each analytical batch (maximum of 20 samples).	See LCS criteria in Table 6-1.2	Investigate the problem and if warranted, analyze a new analytical curve for the out-of-limits compound
Internal Standards (I.S.)	As each standard, blank, and sample is being loaded	For CCVs: area counts 50% - 200%, RT w/in 30 sec of mid-point in ICAL For blanks, samples and non-CCV QC Checks: area counts 60 - 140%, RT w/in 30 sec of RT in CCV	CCV: Inspect and correct system prior to sample analysis. For blanks: inspect the system and reanalyze the blank For condensates: Reanalyze. If out again, flag data. For VOST: Flag the data Evaluate system and correct problem before proceeding
Surrogates	With all samples	See Table 6-1.4	Same as for Internal Standards
Laboratory blanks	Immediately after the calibration standard or after samples with high concentrations (≥ 5000 ng)	Results less than laboratory detection limit (see Table 6-1.1)	Inspect the system and reanalyze the blank
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	Once/batch of condensate samples	See Table 6-1.2	Q flag and narrate

6.2 TO-3 - BTEX & TPH

This method involves GC analysis of whole air samples collected in Summa canisters or Tedlar bags. Samples are analyzed for benzene, toluene, ethylbenzene, xylenes and total petroleum hydrocarbons using Method TO-3 protocols. After cryogenic preconcentration, samples are analyzed using a photoionization detector (PID) and a flame ionization detector (FID). Depending on the client's request, TPH is analyzed and referenced to either gasoline or jet fuel.

ATL performs a modified version of this method. The modifications are detailed in the method specific SOP.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-2.1. Method TO-3

Analyte	DL (ppmv)	Low Point of the Curve (ppmv)	Acceptance Criteria		
			ICAL (%RSD)	ISCV & CCV (%R)	Precision (RPD)
Benzene	0.001	≤ 0.004	≤ 30	± 25	≤ 30
Toluene	0.001	≤ 0.004	≤ 30	± 25	≤ 30
Ethyl Benzene	0.001	≤ 0.004	≤ 30	± 25	≤ 30
Total Xylenes	0.001	≤ 0.004	≤ 30	± 25	≤ 30
C ₂ - C ₄ * Hydrocarbons	0.01	≤ 0.04	≤ 30	± 25	≤ 30
TPH** C ₃ + (Hydrocarbons)	≤ 0.05	≤ 0.14	≤ 30	± 25	≤ 30

* = C₂ - C₄ Hydrocarbons referenced to Propane (MW = 44)

** = TPH referenced to Jet Fuel (MW = 156)

Table 6-2.2. Surrogate

Analyte	Accuracy (% R)
Fluorobenzene	50 - 150

**Table 6-2.3. Summary of Calibration and QC Procedures for Method TO-3
(BTEX and Total Petroleum Hydrocarbons)**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five Point Calibration (ICAL)	Prior to sample analysis.	%RSD \leq 30%	Repeat the calibration.
Independent Source Calibration Verification (ISCV)	With each initial calibration	\pm 25% of the expected value	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Detection Limit Verification (DLV)	With each initial calibration	\pm 50% of the expected value	Check the system and reanalyze the standard. Notify the QA department via a CAR form if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, and after every 10 samples when required for specific projects	\pm 25% of the expected value	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Laboratory Control Sample (LCS)	Daily prior to sample analysis, when required for specific projects	\pm 25% of the expected value	Check the system and reanalyze the standard. Re-prepare the standard if necessary. Recalibrate the instrument if the criteria cannot be met.
Laboratory Blank	In between analysis of standards and project samples	Results less than the laboratory detection limit	Inspect the system and reanalyze the laboratory blank.
Surrogate Spikes	As each standard, blank, and sample is being loaded	\pm 50% of the expected value	Low surrogate recovery results in reanalysis (at a higher dilution if high levels of moisture are present.) If recovery is out still low, report the analysis with the better recovery and flag. Because of TPH interference, high surrogate recoveries do not result in reanalysis. Data is flagged to note high recovery.
End Check	At the end of analytical sequence It can be primary (CCV) or independent source (LCS).	\pm 25% of the expected value	Check system and reanalyze the standard. If the 2 nd analysis fails, identify and correct the problem, then reanalyze a subset of the affected day's samples to determine at what point the analytical system began to fail. Perform reanalysis where necessary.
Laboratory Duplicates	5% of the samples	RPD \leq 30% for detections > 5 X's DL.	Reanalyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found on the system, flag the data

6.3 TO-4/TO-10 – Pesticides and PCBs

This method involves GC analysis of pesticides and Aroclor PCBs in ambient air samples collected on PUF (polyurethane foam) cartridges.

Adsorbent PUF cartridges are cleaned using solvents and vacuum dried. Cartridges are sent to the field wrapped tightly in aluminum foil to prevent degradation by UV light. PUF cartridges are batch certified for cleanliness prior to shipping. In addition, the laboratory analyzes one clean PUF cartridge for each extraction set up to serve as a laboratory blank.

A high volume sampler is used for TO-4 and a low volume sampler is used for method TO-10. A glass fiber filter may also be included in the sampling scheme in order to collect particulate bound matter.

Following sampling the filters and cartridges are subjected to soxhlet extraction with methylene chloride, the solvent is switched to hexane and the extract concentrated. Analysis is performed using a GC/ECD (Electron Capture Detector).

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-3.1. Methods TO-4/TO-10 (Pesticides and PCBs)

Analyte	DL (μ G)	Low Point of the Curve (μ G)	Acceptance Criteria			
			ICAL (%RSD)	ISCV (%R)	CCV (%R)	LCS** (%R)
4,4'-DDD	0.1	0.1	≤ 20	± 20	± 15	
4,4'-DDE	0.1	0.1	≤ 20	± 20	± 15	
4,4'-DDT	0.1	0.1	≤ 20	± 20	± 15	50 - 150
Aldrin	0.1	0.1	≤ 20	± 20	± 15	50 - 150
alpha-BHC	0.1	0.1	≤ 20	± 20	± 15	
Aroclor 1016	1.0	1.0	≤ 20	± 20	± 15	50 - 150
Aroclor 1221*	1.0	1.0	≤ 20	± 20	± 15	
Aroclor 1232*	1.0	1.0	≤ 20	± 20	± 15	
Aroclor 1242*	1.0	1.0	≤ 20	± 20	± 15	
Aroclor 1248*	1.0	1.0	≤ 20	± 20	± 15	
Aroclor 1254*	1.0	1.0	≤ 20	± 20	± 15	
Aroclor 1260	1.0	1.0	≤ 20	± 20	± 15	50 - 150
beta-BHC	0.1	0.1	≤ 20	± 20	± 15	
alpha chlordane	0.1	0.1	≤ 20	± 20	± 15	
gamma chlordane	0.1	0.1	≤ 20	± 20	± 15	
Chlordane* (technical)	1.0	1.0	≤ 20	± 20	± 15	
delta-BHC	0.1	0.1	≤ 20	± 20	± 15	
Dieldrin	0.1	0.1	≤ 20	± 20	± 15	50 - 150
Endosulfan I	0.1	0.1	≤ 20	± 20	± 15	
Endosulfan II	0.1	0.1	≤ 20	± 20	± 15	
Endosulfan Sulfate	0.1	0.1	≤ 20	± 20	± 15	
Endrin	0.1	0.1	≤ 20	± 20	± 15	50 - 150
Endrin Aldehyde	0.1	0.1	≤ 20	± 20	± 15	
Endrin Ketone	0.1	0.1	≤ 20	± 20	± 15	
gamma-BHC	0.1	0.1	≤ 20	± 20	± 15	50 - 150
Heptachlor	0.1	0.1	≤ 20	± 20	± 15	50 - 150
Heptachlor Epoxide	0.1	0.1	≤ 20	± 20	± 15	
Methoxychlor	1.0	1.0	≤ 20	± 20	± 15	
Toxaphene*	1.0	1.0	≤ 20	± 20	± 15	

Surrogates

TCX	NA	NA	NA	NA	≤ 15	51-136**
DCB	NA	NA	NA	NA	≤ 15	57-164**

* The noted multi-component compounds use a one point calibration.

** Recovery limits are subject to change based on internally developed control charts.

Table 6-3.2. Summary of Calibration and QC Procedures for Methods TO-4/TO-10

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five Point Initial Calibration Curve (ICAL)*	Prior to sample analysis	%RSD \leq 20%	Use linear regression per SW-846 or recalibrate
Independent Source Calibration Verification (ISCV)	After each initial calibration	80% to 120% recovery	Investigate the source of discrepancy, including reprep and reanalysis of standard. Recalibrate if needed.
Detection Limit Verification (DLV)	With each initial calibration	\pm 50% of the expected value	Check the system and reanalyze the standard. Notify the QA department via a CAR form if the criteria cannot be met.
Breakdown Check (Endrin and p,p'-DDT)	Daily prior to CCV	Degradation \leq 15%	Perform maintenance. Repeat breakdown check.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, every 10 samples, and at the end of the analysis sequence. At the minimum of every 12 hours.	Recovery of an individual component or the average of all the target components within 15% of the expected values.	Analyze new ICAL and/or prepare fresh standards. If the standard analyzed is recovering high, "Q" flag the high recoveries. If the Standard analyzed is recovering Low re-analyze all samples.
Laboratory Control Spike (LCS)** for compounds noted in Table 6-3.1.	With each set of 20 samples	%R within 50% to 150%	"Q" flag the compounds outside the method limits.
Surrogates**	With all samples and blanks prior to extraction	%R within 50% to 150%	"Q" flag the compounds outside the method limits.
Laboratory blanks	With each set of 20 samples extracted	Results less than the laboratory detection limit	"B" flag the compounds that do not meet the acceptance criteria
Laboratory Duplicates	5% of the samples	RPD \leq 20% for detections > 5 X's DL.	Analyze sample a 3rd time. If criteria still not met, report closest matching pair and "Q" flag data.
Second-column confirmation	100% for all positive results	Same as for initial of primary column analysis	Same as for initial of primary Column analysis

* Single point is performed for technical chlordane and toxaphene

** Recovery limits are subject to change based on internally developed control charts.

6.4 TO-5, TO-11, BIF-0011, and CARB 430 – Aldehydes & Ketones

These methods involve high pressure liquid chromatography (HPLC) analysis of aldehydes and ketones in stationary and ambient air samples. The sampling media consists either of various-sized impingers containing 2,4-Dinitrophenylhydrazine (DNPH) reagent, or a Sep-PAK (silica) cartridge coated in-situ with a solution of DNPH. Aldehydes and Ketones are readily converted to a stable hydrazone derivative. The impinger contents are extracted with a 70:30 hexane/methylene

chloride solution, taken to dryness and reconstituted in acetonitrile. The Sep-PAK cartridges are eluted with acetonitrile using a gravity feed technique. Analysis is performed by reverse phase HPLC with UV detection.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-4.1. Methods: TO-5, TO-11, BIF0011^a and CARB430^a

Analyte	TO-5/TO-11/ CARB430 DL (μ G)	BIF0011 DL (μ G)	Acceptance Criteria		
			ICAL (%RSD)	ISCV (%R)	CCV (%R)
Acetaldehyde	0.10	0.25	≤ 10	± 30	± 10
Acetone	0.75 ^b	0.50	≤ 10	± 30	± 10
Acrolein ^c	0.25	0.50	≤ 10	± 30	± 10
Benzaldehyde	0.25	0.50	≤ 10	± 30	± 10
Crotonaldehyde	0.25	0.50	≤ 10	± 30	± 10
Formaldehyde	0.050	0.25	≤ 10	± 30	± 10
Hexanal	0.25	0.50	≤ 10	± 30	± 10
Isopentanal	0.25	0.50	≤ 10	± 30	± 10
MEK/ Butyraldehydes ^d	0.25	0.50	≤ 10	± 30	± 10
m,p-Tolualdehyde	0.25	0.50	≤ 10	± 30	± 10
o-Tolualdehyde	0.25	0.75 ^b	≤ 10	± 30	± 10
Pentanal	0.25	0.50	≤ 10	± 30	± 10
Propanal	0.25	0.75 ^b	≤ 10	± 30	± 10

^a BIF0011 and CARB 430 samples are typically submitted for formaldehyde and acetaldehyde analysis only.

^b Noted detection limits are subject to change based on most current MDL study.

^c Because its derivative is not stable, when the target analyte list includes acrolein, the sample will need to be extracted in field. A special order needs to be placed with the laboratory during the project set up stage.

^d Methyl Ethyl Ketone and the Butyraldehydes coelute

**Table 6-4.2. Summary of Calibration and QC Procedures for Methods
TO-5, TO-11, BIF0011 and CARB430**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five Point Initial Calibration Curve (ICAL)	Analyzed in triplicate prior to sample analysis	%RSD \leq 10	Repeat calibration.
Independent Source Calibration Verification (ISCV)	With each ICAL	%R = \pm 30	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Detection Limit Verification (DLV)	With each initial calibration	\pm 50% of the expected value	Check the system and reanalyze the standard. Notify QA department via a CAR form if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, after minimum of every 10 samples (typically performed after every 5), and at the end of the analytical batch	\pm 10% of the expected value	Check the system and reanalyze the standard. If the criteria cannot be met, recalibrate the instrument.
Instrument (Solvent) Blank Analysis	In between analysis of standards and project samples	Results less than the laboratory detection limit	Inspect the system and reanalyze the blank.
Laboratory Duplicates	10% of samples	RPD \leq 30% for detections > 5 X's DL.	Reanalyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, flag the data
Laboratory Spikes	With each work order	Recovery limits are \pm 30% of expected value	Flag the recoveries outside of the acceptance criteria.
Laboratory Blanks*	With each work order	Results less than the laboratory detection limit**	Flag the data for detections are above the detection limit*.
Trip/Field Spikes (excluding TO-11)	With each work order	Recovery limits are \pm 30% of expected value	Flag the recoveries outside of the acceptance criteria.
Trip/Field Blanks*	With each work order	Detections of target analytes below the detection limit**	Flag the data for detections are above the detection limit*.

* Due to the ubiquitous nature of formaldehyde and acetone in both field and laboratory operations, low levels of these two compounds are likely to be present.

** Any detections in laboratory, trip or field blanks are subtracted from the associated spikes. Blank subtraction is not performed on project samples.

6.5 TO-8 - Phenols

This methods involves high pressure liquid chromatography (HPLC) analysis of phenol and methylphenols (cresols) in ambient air samples. The sampling media consists two midiget impingers each containing of 0.1 N NaOH. The phenols are collected as phenolates. The impinger contents are extracted with a 5% sulfuric acid solution.

Analysis is performed using isocratic reverse phase HPLC with UV detection.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-5.1. Method TO-8

Analyte	DL (μ G)	Low Point of the Curve (μ G)	Acceptance Criteria		
			ICAL (%RSD)	ISCV (%R)	CCV (%R)
2-Methylphenol (o-Cresol)	5.0	5.0	$\leq 20\%$	± 30	± 10
m,p-Cresol	5.0	10.0	$\leq 20\%$	± 30	± 10
Phenol	5.0	5.0	$\leq 20\%$	± 30	± 10

Table 6-5.2. Summary of Calibration and QC Procedures for Method TO-8

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five-point ICAL in triplicate	Prior to Sample Analysis.	%RSD ≤ 20	Correct problem then repeat initial calibration
Independent Source Check Standard (ISCV)	All analytes - once per initial calibration	$\pm 30\%$ of the expected value	Investigate the problem and if warranted, analyze a new analytical curve for the out-of-limits compound
Continuing Calibration Verification (CCV)	Daily: - prior to sample analysis, every 10 samples, after last sample of the day, as an end check	$\pm 10\%$ of the expected value	Check the system and reanalyze the standard. If the criteria cannot be met, recalibrate the instrument.
Instrument Blank	After each CCV except End Check	Results less than laboratory detection limit.	Inspect the system and reanalyze the blank.
Laboratory Blanks	With each set of samples	Results less than laboratory detection limit	Inspect the system and reanalyze the blank. If contamination still present, "B" flag associated sample detections.
Laboratory Spikes	With each set of samples	% Recovery between 70- 130%.	"Q" flag the compounds outside the acceptance criteria
Sample Duplicates	10% of the samples	RPD $\leq 30\%$ for detections $>$ 5 X's DL.	Reanalyze the sample a 3 rd time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, report pair with best agreement and flag data.

6.6 TO-12 - NMOC

This method involves GC analysis of whole air samples collected in Summa canisters or Tedlar bags. Samples are analyzed for Non-methane Organic Compounds (NMOC) using Method TO-12 protocols. After cryogenic preconcentration, samples are analyzed using a flame ionization detector

(FID). This method is used when speciation is not required.

The standard target analyte list, reported detection limits, QC - criteria, and QC summary can be found in the following tables.

Table 6-6.1. Method TO - 12

Analyte	DL (ppmv)	Low Point of the Curve (ppmv)	Acceptance Criteria		
			ICAL (%RSD)	ISCV & CCV (%R)	Precision (RPD)
TNMOC ref. to Heptane (MW = 100)	0.01	≤ 0.05	≤ 30	± 25	≤ 30

Table 6-6.2. Summary of Calibration and QC Procedures for Method TO-12

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration Curve (ICAL)	Prior to sample analysis.	$\%RSD \leq 30\%$	Repeat the calibration.
Independent Source Calibration Verification (ISCV)	With each initial calibration	$\pm 25\%$ of the expected value	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Detection Limit Verification (DLV)	With each initial calibration	$\pm 50\%$ of the expected value	Check the system and reanalyze the standard. Notify QA department via a CAR form if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and after every 20 samples.	$\%R$ between 75 - 125	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Laboratory Blank	In between analysis of standards and project samples	Results less than laboratory detection limit	Repeat the laboratory blank.
End Check	At the end of analytical sequence It can be primary (CCV) or independent Source (LCS).	$\pm 25\%$ of the expected value	Check system and reanalyze the standard. If the 2 nd analysis fails, identify and correct the problem, then reanalyze a subset of the affected day's samples to determine at what point the analytical system began to fail. Perform reanalysis when needed.
Sample Duplicates	5% of the samples	$RPD \leq 30\%$ for detections > 5 X's the DL.	Reanalyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, flag the data

6.7 TO-13 – Semivolatile Compounds

This method involves GC/MS full scan analysis of semivolatile organic compounds in ambient air samples collected on PUF (polyurethane foam)/XAD2 cartridges. Samples are extracted using a modification of SW846 EPA Method 3542, and analyzed for polynuclear aromatic hydrocarbons (PAHs) using a quadrupole GC/MS in the full scan mode by TO-13 protocol. In addition, the target compound list is often extended to include analysis of Method 8270 semi volatile compounds.

ATL performs a modified version of this method. The modifications are detailed in the method specific SOP.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

ATL also performs semivolatile analysis by SW-846 Method 8270C. The extraction process follows SW846 Method 3542, and the QC criteria differ from Method TO-13 analysis. The QC criteria and QC summary tables for Method 8270C analysis are in this section following the TO-13 tables.

Table 6-7.1. Method TO-13 PAH Compound List

Analyte	Detection Limit (µG)	Acceptance Criteria		
		ICAL (%RSD)	ISCV (%R)	CCV (%R)
2-Chloronaphthalene	1.0	≤ 30	± 50	± 30%
2-Methylnaphthalene	1.0	≤ 30	± 50	± 30%
Acenaphthylene	1.0	≤ 30	± 50	± 30%
Acenaphthene	1.0	≤ 30	± 50	± 30%
Anthracene	1.0	≤ 30	± 50	± 30%
Benzo(a)anthracene	1.0	≤ 30	± 50	± 30%
Benzo(a)pyrene	1.0	≤ 30	± 50	± 30%
Benzo(b)fluoranthene	1.0	≤ 30	± 50	± 30%
Benzo(g,h,i)perylene	1.0	≤ 30	± 50	± 30%
Benzo(k)fluoranthene	1.0	≤ 30	± 50	± 30%
Chrysene	1.0	≤ 30	± 50	± 30%
Dibenz(a,h)anthracene	1.0	≤ 30	± 50	± 30%
Fluoranthene	1.0	≤ 30	± 50	± 30%
Fluorene	1.0	≤ 30	± 50	± 30%
Indeno(1,2,3-c,d)pyrene	1.0	≤ 30	± 50	± 30%
Naphthalene	1.0	≤ 30	± 50	± 30%
Phenanthrene	1.0	≤ 30	± 50	± 30%
Pyrene	1.0	≤ 30	± 50	± 30%

Table 6-7.2. Method TO-13 Semivolatile Organic Compounds List

Analyte	Detection Limit (μ G)	Acceptance Criteria		
		ICAL (%RSD)*	ISCV (%R)	CCV
1,2,4-Trichlorobenzene	1.0	≤ 15	± 50	-
1,2-Dichlorobenzene	1.0	≤ 15	± 50	-
1,3-Dichlorobenzene	1.0	≤ 15	± 50	-
1,4-Dichlorobenzene - CCC	1.0	≤ 30	± 50	%D $\leq 30\%$
2,4,5-Trichlorophenol	5.0	≤ 15	± 50	-
2,4,6-Trichlorophenol - CCC	5.0	≤ 30	± 50	%D $\leq 30\%$
2,4-Dichlorophenol - CCC	5.0	≤ 30	± 50	%D $\leq 30\%$
2,4-Dimethylphenol	5.0	≤ 15	± 50	-
2,4-Dinitrophenol - SPCC	20	≤ 50	± 50	RF ≥ 0.050
2,4-Dinitrotoluene	5.0	≤ 15	± 50	-
2,6-Dinitrotoluene	5.0	≤ 15	± 50	-
2-Chloronaphthalene	1.0	≤ 15	± 50	-
2-Chlorophenol	5.0	≤ 15	± 50	-
2-Methylnaphthalene	1.0	≤ 15	± 50	-
2-Methylphenol	5.0	≤ 15	± 50	-
2-Nitroaniline	10	≤ 50	± 50	-
2-Nitrophenol - CCC	5.0	≤ 30	± 50	%D $\leq 30\%$
3,3-Dichlorobenzidine	20	≤ 50	± 50	-
3-Nitroaniline	10	≤ 50	± 50	-
4,6-Dinitro-2-methylphenol	10	≤ 50	± 50	-
4-Bromophenyl-phenyl ether	1.0	≤ 15	± 50	-
4-Chloro-3-methylphenol - CCC	5.0	≤ 30	± 50	%D $\leq 30\%$
4-Chloroaniline	10	≤ 50	± 50	-
4-Chlorophenyl-phenyl ether	1.0	≤ 15	± 50	-
4-Methylphenol	5.0	≤ 15	± 50	-
4-Nitroaniline	10	≤ 50	± 50	-
4-Nitrophenol - SPCC	20	≤ 50	± 50	RF ≥ 0.050
Acenaphthylene	1.0	≤ 15	± 50	-
Acenaphthene - CCC	1.0	≤ 30	± 50	%D $\leq 30\%$
Anthracene	1.0	≤ 15	± 50	-
Benzo(a)anthracene	1.0	≤ 15	± 50	-
Benzo(a)pyrene - CCC	1.0	≤ 30	± 50	%D $\leq 30\%$
Benzo(b)fluoranthene	1.0	≤ 15	± 50	-
Benzo(g,h,i)perylene	1.0	≤ 15	± 50	-
Benzo(k)fluoranthene	1.0	≤ 15	± 50	-
Benzoic Acid	30	≤ 50	± 50	-
bis(2-Chloroethoxy) Methane	1.0	≤ 15	± 50	-
bis(2-Chloroisopropyl) Ether	1.0	≤ 15	± 50	-
bis(2-Chloroethyl) Ether	1.0	≤ 15	± 50	-
bis(2-Ethylhexyl)phthalate	5.0	≤ 15	± 50	-
Butylbenzylphthalate	5.0	≤ 15	± 50	-
Chrysene	1.0	≤ 15	± 50	-
di-n-Butylphthalate	5.0	≤ 15	± 50	-
di-n-Octylphthalate - CCC	5.0	≤ 30	± 50	%D $\leq 30\%$
Dibenz(a,h)anthracene	1.0	≤ 15	± 50	-

continued

Table 6-7.2. Method TO-13 Semivolatile Organic Compounds List, (continued)

Analyte	DL (μ G)	ICAL %RSD*	ISCV (%R)	CCV Criteria
Dibenzofuran	1.0	≤ 15	± 50	-
Diethylphthalate	5.0	≤ 15	± 50	-
Dimethylphthalate	5.0	≤ 15	± 50	-
Fluoranthene - CCC	1.0	≤ 30	± 50	%D $\leq 30\%$
Fluorene	1.0	≤ 15	± 50	-
Hexachlorobenzene	1.0	≤ 15	± 50	-
Hexachlorobutadiene - CCC	1.0	≤ 30	± 50	%D $\leq 30\%$
Hexachlorocyclopentadiene - SPCC	20	≤ 50	± 50	RF ≥ 0.050
Hexachloroethane	1.0	≤ 15	± 50	-
Indeo(1,2,3-c,d)pyrene	1.0	≤ 15	± 50	-
Isophorone	1.0	≤ 15	± 50	-
n-Nitroso-di-n-propylamine - SPCC	1.0	≤ 50	± 50	RF ≥ 0.050
n-Nitrosodiphenylamine - CCC	10	≤ 15	± 50	%D $\leq 30\%$
Napthalene	1.0	≤ 15	± 50	-
Nitrobenzene	1.0	≤ 15	± 50	-
Pentachlorophenol - CCC	20	≤ 30	± 50	%D $\leq 30\%$
Phenanthrene	1.0	≤ 15	± 50	-
Phenol - CCC	5.0	≤ 30	± 50	%D $\leq 30\%$
Pyrene	1.0	≤ 15	± 50	-

* Can use the mean RSD criterion of $\leq 15\%$ as noted in par. 7.5.1.2.1 of SW-846, 8000B.

Table 6-7.3. Surrogates

Analyte	(%R)**
2,4,6-Tribromophenol	9 - 98
2-Fluorobiphenyl	15 - 98
2-Fluorophenol	7 - 85
Nitrobenzene-d ₅	14 - 92
Phenol-d ₅	2 - 94
p-Terphenyl-d ₁₄	19 - 162

Table 6-7.4 Internal Standards

Analyte	(%R)
Acenaphthene-d ₁₀	50 - 200
Chrysene-d ₁₂	50 - 200
1,4-Dichlorobenzene-d ₄	50 - 200
Naphthalene-d ₈	50 - 200
Perylene-d ₁₂	50 - 200
Phenanthrene-d ₁₀	50 - 200

Table 6-7.5. Extracted Laboratory Control Spikes

Analyte	(%R)**
1,2,4-Trichlorobenzene	4 - 115
1,4-Dichlorobenzene	6 - 101
2,4-Dinitrotoluene	24 - 106
2-Chlorophenol	8 - 98
4-Chloro-3-methylphenol	10 - 104
4-Nitrophenol	11 - 125
Acenaphthene	7 - 106
N-Nitroso-di-n-propylamine	10 - 95
Pentachlorophenol	3 - 138
Phenol	7 - 96
Pyrene	48 - 108

** The LCS and surrogate limits are in-house limits that are updated quarterly. These limits are only applied to samples that are extracted by ATL. When sample extracts are sent to ATL, limits of 50% - 150% are applied.

Table 6-7.6. Summary of Calibration and QC Procedures for EPA Method TO-13

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Prior to calibration and at start of every 12 hrs.	SW-846 tuning criteria for semivolatiles analysis	Correct problem then repeat tune.
Initial 5-Point Calibration	Prior to sample analysis	ICAL criteria in Tables 6-7.1 & 6-7.2	Correct problem then repeat initial calibration. -
Independent Source Calib. Ver. (ISCV)	All analytes – Once per initial calibration	At least 90% of the target compound recoveries must be between 50% - 150%.	Determine the source of discrepancy between standards. Recalibrate if needed.
Detection Limit Verification (DLV)	With each initial Calibration	$\pm 50\%$ of the expected value	Check the system and reanalyze the standard. Notify QA dept. via a CAR form if the criteria cannot be met.
Continuing Calibration Verification (CCV)	At the start of every clock immediately after the DFTPP tune check	PAHs list only: $\%D \leq 30\%$ Extended list: SPCCs: $RF \geq 0.050$ CCCs: $\%D \leq 30\%$	Investigate and correct the problem, up to and including re-calibration if necessary.
Internal Standards (IS)	As each standard, blank, and sample is being loaded	For CCVs: area counts within 50% to 200% and retention times within 30 seconds of the mid-level standard from the most recent initial calibration For blanks, samples and non-CCV QC Checks: retention times within ± 0.5 minutes (30 seconds) and area counts within 50% to 200% of the CCV	For CCVs: Investigate and correct the problem before proceeding with sample analysis. If interferences are present, a secondary ion may be selected For blanks: inspect the system and reanalyze the blank For samples and non-CCV QC: reanalyze the samples. If the criteria is not met a second time, flag the data to indicate interference.
Surrogates	With all samples and blanks prior to extraction	See Table 6-7.3	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise narrate
Extracted LCS	With each set of up to 20 extracted samples	See LCS Criteria in Table 6-7.5	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise narrate
Laboratory Blank	With each set of up to 20 extracted samples, immediately after the calibration standard	Results less than laboratory detection limit (Tables 6-7.1 & 6-7.2)	Flag the data.
Solvent Blanks	When samples that are extracted together are analyzed on different analytical shifts	All target compounds below the detection limit (Tables 6-7.1 & 6-7.2)	Flag the data.
Laboratory Duplicates	With each set of up to 20 extracted samples.	RPD $< \text{or} = 30\%$ for all detections $> 5 \times$ DLs	Flag the data.

Table 6-7.7. SW-846 Modified Method 8270C

Analyte	Detection Limit (µG)	Acceptance Criteria		
		ICAL (%RSD)*	ISCV (% R)	CCV
1,2,4-Trichlorobenzene	1.0	≤ 15	± 50	-
1,2-Dichlorobenzene	1.0	≤ 15	± 50	-
1,3-Dichlorobenzene	1.0	≤ 15	± 50	-
1,4-Dichlorobenzene – CCC	1.0	≤ 30	± 50	%D ≤ 20%
2,4,5-Trichlorophenol	5.0	≤ 15	± 50	-
2,4,6-Trichlorophenol – CCC	5.0	≤ 30	± 50	%D ≤ 20%
2,4-Dichlorophenol – CCC	5.0	≤ 30	± 50	%D ≤ 20%
2,4-Dimethylphenol	5.0	≤ 15	± 50	-
2,4-Dinitrophenol - SPCC	20	≤ 50	± 50	RF ≥ 0.050
2,4-Dinitrotoluene	5.0	≤ 15	± 50	-
2,6-Dinitrotoluene	5.0	≤ 15	± 50	-
2-Chloronapthalene	1.0	≤ 15	± 50	-
2-Chlorophenol	5.0	≤ 15	± 50	-
2-Methylnapthalene	1.0	≤ 15	± 50	-
2-Methylphenol	5.0	≤ 15	± 50	-
2-Nitroaniline	10	≤ 50	± 50	-
2-Nitrophenol – CCC	5.0	≤ 30	± 50	%D ≤ 20%
3,3-Dichlorobenzidine	20	≤ 50	± 50	-
3-Nitroaniline	10	≤ 50	± 50	-
4,6-Dinitro-2-methylphenol	10	≤ 50	± 50	-
4-Bromophenyl-phenyl ether	1.0	≤ 15	± 50	-
4-Chloro-3-methylphenol – CCC	5.0	≤ 30	± 50	%D ≤ 20%
4-Chloroaniline	10	≤ 50	± 50	-
4-Chlorophenyl-phenyl ether	1.0	≤ 15	± 50	-
4-Methylphenol	5.0	≤ 15	± 50	-
4-Nitroaniline	10	≤ 50	± 50	-
4-Nitrophenol - SPCC	20	≤ 50	± 50	RF ≥ 0.050
Acenaphthylene	1.0	≤ 15	± 50	-
Acenaphthene - CCC	1.0	≤ 30	± 50	%D ≤ 20%
Anthracene	1.0	≤ 15	± 50	-
Benzo(a)anthracene	1.0	≤ 15	± 50	-
Benzo(a)pyrene - CCC	1.0	≤ 30	± 50	%D ≤ 20%
Benzo(b)fluoranthene	1.0	≤ 15	± 50	-
Benzo(g,h,i)perylene	1.0	≤ 15	± 50	-
Benzo(k)fluoranthene	1.0	≤ 15	± 50	-
Benzoic Acid	30	≤ 50	± 50	-
bis(2-Chloroethoxy) Methane	1.0	≤ 15	± 50	-
bis(2-Chloroisopropyl) Ether	1.0	≤ 15	± 50	-
bis(2-Chloroethyl) Ether	1.0	≤ 15	± 50	-
bis(2-Ethylhexyl)phthalate	5.0	≤ 15	± 50	-
Butylbenzylphthalate	5.0	≤ 15	± 50	-
Chrysene	1.0	≤ 15	± 50	-
di-n-Butylphthalate	5.0	≤ 15	± 50	-
di-n-Octylphthalate - CCC	5.0	≤ 30	± 50	%D ≤ 20%
Dibenz(a,h)anthracene	1.0	≤ 15	± 50	-

continued

Table 6-7.7. SW-846 Modified Method 8270C, (continued)

Analyte	DL (µG)	ICAL %RSD*	ISCV (% R)	CCV Criteria
Dibenzofuran	1.0	≤ 15	± 50	-
Diethylphthalate	5.0	≤ 15	± 50	-
Dimethylphthalate	5.0	≤ 15	± 50	-
Fluoranthene - CCC	1.0	≤ 30	± 50	%D ≤ 20%
Fluorene	1.0	≤ 15	± 50	-
Hexachlorobenzene	1.0	≤ 15	± 50	-
Hexachlorobutadiene - CCC	1.0	≤ 30	± 50	%D ≤ 20%
Hexachlorocyclopentadiene - SPCC	20	≤ 50	± 50	RF ≥ 0.050
Hexachloroethane	1.0	≤ 15	± 50	-
Indeo(1,2,3-c,d)pyrene	1.0	≤ 15	± 50	-
Isophorone	1.0	≤ 15	± 50	-
n-Nitroso-di-n-propylamine - SPCC	1.0	≤ 50	± 50	RF ≥ 0.050
n-Nitrosodiphenylamine - CCC	10	≤ 15	± 50	%D ≤ 20%
Napthalene	1.0	≤ 15	± 50	-
Nitrobenzene	1.0	≤ 15	± 50	-
Pentachlorophenol - CCC	20	≤ 30	± 50	%D ≤ 20%
Phenanthrene	1.0	≤ 15	± 50	-
Phenol - CCC	5.0	≤ 30	± 50	%D ≤ 20%
Pyrene	1.0	≤ 15	± 50	-

* Can use the mean RSD criterion of ≤ 15% as noted in par. 7.5.1.2.1 of SW-846, 8000B.

Table 6-7.8. Surrogates

Analyte	(%R)**
2,4,6-Tribromophenol	9 - 98
2-Fluorobiphenyl	15 - 98
2-Fluorophenol	7 - 85
Nitrobenzene-d ₅	14 - 92
Phenol-d ₅	2 - 94
p-Terphenyl-d ₁₄	19 - 162

Table 6-7.9 Internal Standards

Analyte	(%R)
Acenaphthene-d ₁₀	50 - 200
Chrysene-d ₁₂	50 - 200
1,4-Dichlorobenzene-d ₄	50 - 200
Naphthalene-d ₈	50 - 200
Perylene-d ₁₂	50 - 200
Phenanthrene-d ₁₀	50 - 200

Table 6-7.10. Extracted Laboratory Control Spikes

Analyte	(%R)**
1,2,4-Trichlorobenzene	4 - 115
1,4-Dichlorobenzene	6 - 101
2,4-Dinitrotoluene	24 - 106
2-Chlorophenol	8 - 98
4-Chloro-3-methylphenol	10 - 104
4-Nitrophenol	11 - 125
Acenaphthene	7 - 106
N-Nitroso-di-n-propylamine	10 - 95
Pentachlorophenol	3 - 138
Phenol	7 - 96
Pyrene	48 - 108

** The LCS and surrogate limits are in-house limits that are updated quarterly. These limits are only applied to samples that are extracted by ATL. When sample extracts are sent to ATL, limits of 50% - 150% are applied.

Table 6-7.11. Summary of Calibration and QC Procedures for SW-846 Modified Method 8270C

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Prior to calibration and at start of every 12 hrs.	SW-846 tuning criteria for semivolatiles analysis	Correct problem then repeat tune.
Initial 5-Point Calibration	Prior to sample analysis	ICAL criteria in Tables 6-7.7	Correct problem then repeat initial calibration.
Independent Source Calib. Ver. (ISCV)	All analytes - Once per initial calibration	At least 90% of the target compound recoveries must be between 50% - 150%.	Determine the source of discrepancy between standards. Recalibrate if needed.
Detection Limit Verification (DLV)	With each initial calibration	$\pm 50\%$ of the expected value	Check the system and reanalyze the standard. Notify QA dept. via a CAR form if the criteria cannot be met.
Continuing Cal. Verification (CCV)	At the start of every clock immediately after the DFTPP tune check	SPCCs: $RF \geq 0.050$ CCCs: $\%D \leq 20\%$	Investigate and correct the problem, up to and including re-calibration if necessary.
Internal Standards (IS)	As each standard, blank, and sample is being loaded	For CCVs: area counts within 50% to 200% and retention times within 30 seconds of the mid-level standard from the most recent initial calibration For blanks, samples and non-CCV QC Checks: retention times within ± 0.5 minutes (30 seconds) and area counts within 50% to 200% of the CCV	For CCVs: Investigate and correct the problem before proceeding with sample analysis. If interferences are present, a secondary ion may be selected For blanks: inspect the system and reanalyze the blank For samples and non-CCV QC: reanalyze the samples. If the criteria is not met a second time, flag the data to indicate interference.
Surrogates	With all samples and blanks prior to extraction	See Table 6-7.8	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise narrate
Extracted LCS	With each set of up to 20 extracted samples	See LCS Criteria in Table 6-7.10	Re-aliquot and re-analyze the extract. If within limits, report the re-analysis. Otherwise narrate
Laboratory Blank	With each set of up to 20 extracted samples, immediately after the calibration standard	Results less than the laboratory detection limit (Tables 6-7.7)	Flag the data.
Solvent Blanks	When samples that are extracted together are analyzed on different analytical shifts	Results less than the laboratory detection limit (Tables 6-7.7)	Flag the data.
Laboratory Duplicates	With each set of up to 20 extracted samples.	RPD $< \text{or} = 30\%$ for all detections $> 5 \times$ DLs	Flag the data.

6.8 TO-14/TO-15 – Volatile Organic Compounds

This method involves full scan GC/MS analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds using Method TO-14/15 protocols. An aliquot of the sample is withdrawn from the canister through a mass flow controller and either cryofocused via liquid argon or concentrated using a multisorbent bed. The focused air sample is then flash heated through a hydrophobic drying system which removes water from the sample stream prior to analysis by full

scan GC/MS. For low level analysis, a cryogenic valve is employed to cold trap the gases onto the GC column.

ATL performs a modified version of this method. The modifications are detailed in the method specific SOP.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-8.1. Method TO-14/TO-15 (Standard Compounds)

Analyte	DL (ppbv) Low Level/ Standard	Low Point of Curve (ppbv) Low Level/ Standard	Acceptance Criteria		
			ICAL (%RSD)	ISCV & CCV (%R)*	Precision (RPD)
1,1,2,2-Tetrachloroethane	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30 ⁻	≤ 25
1,1,2-Trichloroethane	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,1-Dichloroethane	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,1-Dichloroethene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,2,4-Trichlorobenzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,2,4-Trimethylbenzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,2-Dibromoethane (EDB)	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,2-Dichlorobenzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,2-Dichloroethane	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,2-Dichloropropane	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,3,5-Trimethylbenzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,3-Dichlorobenzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
1,4-Dichlorobenzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Benzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Bromomethane	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Carbon Tetrachloride	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Chlorobenzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Chloroethane	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Chloroform	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Chloromethane	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Chlorotoluene (Benzyl Chloride)	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
cis-1,2-Dichloroethene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
cis-1,3-Dichloropropene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Dichloromethane (Methylene Chloride)	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Ethylbenzene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Freon 11 (Trichlorofluoromethane)	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Freon 113 (Trichlorotrifluoroethane)	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Freon 114	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Freon 12 (Dichlorodifluoromethane)	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Hexachlorobutadiene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
m,p-Xylene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Methyl Chloroform (1,1,1-TCA)	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
o-Xylene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Styrene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Tetrachloroethene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Toluene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
trans-1,3-Dichloropropene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Trichloroethene	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25
Vinyl Chloride	0.1 / 0.5	≤ 0.1 / 2.0	≤ 30	± 30	≤ 25

* Up to 10% allowed to exceed %R criterion

continued

**Table 6-8.1. Method TO-14/TO-15 (continued)
(Non-Standard and Polar Compounds)**

Analyte	DL (ppbv) Low Level/ Standard	Low Point of Curve (ppbv) Low Level/ Standard	Acceptance Criteria		
			ICAL (%RSD)	ISCV & CCV (%R)**	Precision (RPD)
1,3-Butadiene	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
1,4-Dioxane	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
2-Butanone (Methyl Ethyl Ketone)	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
2-Hexanone	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
4-Ethyltoluene	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
4-Methyl-2-Pentanone (MIBK)	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Acetone	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Bromodichloromethane	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Bromoform	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Carbon Disulfide	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Cyclohexane	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Dibromochloromethane	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Ethanol	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Heptane	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Hexane	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Isopropanol	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Methyl t-Butyl Ether (MTBE)	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Propylene	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Tetrahydrofuran	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
trans-1,2-Dichloroethene	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25
Vinyl Acetate	0.5 / 2.0	≤ 0.5 / 5.0	≤ 40	± 40	≤ 25

** Up to 20% allowed to exceed %R criterion

Table 6-8.2. Internal Standards (I.S.)

Analyte	% Recovery
Bromochloromethane	60 - 140
1,4-Difluorobenzene	60 - 140
Chlorobenzene-d ₅	60 - 140

Table 6-8.3. Surrogates

Analyte	% Recovery
1,2-Dichloroethane-d ₄	70 - 130
Toluene-d ₈	70 - 130
4-Bromofluorobenzene	70 - 130

Table 6-8.4. Summary of Calibration and QC Procedures for Methods TO-14/TO-15

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours, or every 12 hours if project requires	SW - 846 tune criteria	Correct problem then repeat tune
5 Point Calibration	Prior to sample analysis	%RSD \leq 30% for all "Standard" compounds and %RSD \leq 40% for all "Non-standard" compounds	Correct problem then repeat initial calibration curve
Independent Source Calibration Verification (ISCV)	After each initial calibration curve	Recoveries for 90% of "Standard" compounds must be \pm 30%; for 80% of "Non-standard" compounds recoveries must be \pm 40%.	Investigate the problem and if warranted, analyze a new analytical curve for the out-of-limits compounds
Detection Limit Verification (DLV)	With each initial calibration	\pm 50% of the expected value	Check the system and reanalyze the standard. Notify QA department via a CAR form if the criteria cannot be met.
Continuing Calibration Verification (CCV)	At the start of each day and, if required by a specific project, every 12 hours	%D \leq 30% for 90% of "Standard" compounds; %D \leq 40% for 80% of the "Non-standard" compounds	Perform maintenance and repeat test. If the system still fails the CCV, perform a new 5 point calibration curve
LCS (Subset of Target Compounds)	Daily prior to sample analysis, when required for specific projects	%R \leq 30% for 90% of "Standard" compounds; %R \leq 40% for 80% of the "Non-standard" compounds	Check the system and reanalyze the standard. Re-prepare the standard if necessary. Recalibrate the instrument if the criteria cannot be met.
Laboratory Blank	After the CCV	Results less than the laboratory detection limit (Tables 6-8.1 & 2).	Inspect the system and reanalyze the blank.
Internal Standard (IS)	As each standard, blank, and sample is being loaded	Retention time (R.T.) for the blanks and samples must be within \pm 0.5 minutes of the R.T. in the CCV The IS area must be within \pm 40% of the CCV's IS area for the blanks and samples	For blanks: inspect the system and reanalyze the blank For samples: reanalyze the sample unless obvious matrix interference is documented. If the IS are within limits in the re-analysis, report the second analysis. If IS are out of limits a second time, report data from first analysis and narrate

continued

Table 6-8.4. Summary of Calibration and QC Procedures for Methods TO-14/TO-15 (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Surrogates	As each standard, blank, and sample is being loaded	70 - 130%	For blanks: inspect the system and reanalyze the blank For samples: reanalyze sample unless obvious matrix interference is documented. If the %R are within limits in the re-analysis, report the second analysis. If %R are out of limits a second time & narrate
Laboratory Duplicates	5% of the samples	RPD \leq 25% for detections > 5 X's the DL.	Reanalyze the sample a third time. If the limit is exceeded again, Investigate the cause and bring the system back to working order. If no problem is found with the system, flag the data

6.9 ASTM D1945 – Fixed Gases

This method involves GC analysis of landfill gas, ambient air or stack gas collected in Summa canisters or Tedlar bags or any vessel that has been demonstrated to be clean and leak free. Samples are analyzed for methane and fixed gases and can be used to speciate individual light hydrocarbons up to C6. This method is also used to determine caloric content of the gas. Because the sample is withdrawn from the vessel by positive pressure, rigid containers are first filled to positive pressure using

UHP helium or nitrogen. Samples are then analyzed using a GC equipped with a flame ionization detector (FID) and a thermal conductivity detector (TCD).

ATL performs a modified version of this method. The modifications are detailed in the method specific SOP.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-9.1. ASTM Modified Method D1945

Analyte	Detection Limit (%)	Acceptance Criteria		
		ICAL (%D)	End Check (%R)	Precision (RPD)
Carbon Dioxide	0.001	≤ 25%	± 25%	≤ 25%
Carbon Monoxide	0.001	≤ 25%	± 25%	≤ 25%
Ethane	0.001	≤ 25%	± 25%	≤ 25%
Isobutane	0.001	≤ 25%	± 25%	≤ 25%
Isopentane	0.001	≤ 25%	± 25%	≤ 25%
Methane	0.001	≤ 25%	± 25%	≤ 25%
n-Butane	0.001	≤ 25%	± 25%	≤ 25%
n-Pentane	0.001	≤ 25%	± 25%	≤ 25%
Nitrogen*	0.10	≤ 25%	± 25%	≤ 25%
NMOC (C6+)	0.01	≤ 25%	± 25%	≤ 25%
Oxygen	0.10	≤ 25%	± 25%	≤ 25%
Propane	0.001	≤ 25%	± 25%	≤ 25%

* For samples that have been pressurized with N2, the amount of N2 in the sample is determined by subtraction.

Table 6-9.2. Summary of Calibration and QC Procedures for ASTM Modified Method D1945

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Single Point Daily Calibration	Prior to Sample Analysis	The deviation of the daily response from the most recent previous day's response is $\leq 25\%$.	Perform maintenance of the instrument, validate the standard against a second source or run periodic check standards to show the stability of the instrument throughout the analytical day.
Laboratory Blank	Daily	Results less than the laboratory detection limit	Analyze additional blanks until the system is free of contamination.
Sample Duplicates	5% of the samples	RPD $\leq 25\%$ for detections > 5 times the DL.	Reanalyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, flag the data.
End Check	At the end of the analytical sequence	$\pm 25\%$ of the expected value	Check system and reanalyze the standard. If the 2 nd analysis fails, identify and correct the problem, then reanalyze a subset of the affected day's samples to determine at what point the analytical system began to fail. Perform reanalysis when needed.
Chromatographic Resolution of CH ₄ from CO	As needed	> 50% valley	Recondition the molecular sieve column at similar levels.
Response of CO and CO ₂	As needed	< 30%	Repack the tube with fresh catalyst and allow to stabilize overnight with N ₂ flowing at 375°C.

6.10 ASTM D1946 – Atmospheric Gases

This method involves GC analysis of landfill gas, ambient air or stack gas collected in Summa canisters or Tedlar bags or any vessel that has been demonstrated to be clean and leak free. Samples are analyzed for methane, fixed gases and non-methane organic carbon using ASTM D1946 protocols. Because the sample is withdrawn from the vessel by positive pressure, rigid containers are first filled to positive pressure using UHP helium or nitrogen. Samples are

then analyzed using a GC equipped with a flame ionization detector (FID) and a thermal conductivity detector (TCD).

ATL performs a modified version of this method. The modifications are detailed in the method specific SOP.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-10.1. ASTM Modified Method D1946

Analyte	Detection Limit (%)	Acceptance Criteria			
		ICAL (%RSD)	ISCV (%R)	CCV/LCS (%R)	Precision (RPD)
Carbon Dioxide	0.001	≤ 25%	± 25%	± 25%	≤ 25%
Carbon Monoxide	0.001	≤ 25%	± 25%	± 25%	≤ 25%
Methane	0.001	≤ 25%	± 25%	± 25%	≤ 25%
Ethene*	0.001	≤ 25%	± 25%	± 25%	≤ 25%
Ethane*	0.001	≤ 25%	± 25%	± 25%	≤ 25%
Nitrogen**	0.1	≤ 25%	± 25%	± 25%	≤ 25%
NMOC	0.01	≤ 25%	± 25%	± 25%	≤ 25%
Oxygen	0.1	≤ 25%	± 25%	± 25%	≤ 25%

* Ethene & Ethane are included by special request only

** Nitrogen is typically determined by percent difference

Table 6-10.2. Summary of Calibration and QC Procedures for ASTM Modified Method D1946

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration Curve (ICAL)	Prior to Sample Analysis	ICAL criteria in Table 6-10.1	Correct problem then repeat initial calibration.
Independent Source Check Verification (ISCV)	All Analytes - Once per initial calibration	ISCV criteria in Table 6-10.1	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Detection Limit Verification (DLV)	With each initial calibration	$\pm 50\%$ of the expected value	Check the system and reanalyze the standard. Notify QA dept. via a CAR form if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and after every 20 samples.	%R between 75 - 125	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Laboratory Blank	Immediately after each daily check standard and prior to sample analysis, or when contamination is present	Results below the reporting limit	Inspect the system and reanalyze the blank
End Check	At the end of analytical sequence It can be primary (CCV) or independent Source (LCS).	$\pm 25\%$ of the expected value	Check system and reanalyze the standard. If the 2 nd analysis fails, identify and correct the problem, then reanalyze a subset of the affected day's samples to determine at what point the analytical system began to fail. Perform reanalysis when needed.
Sample Duplicates	5% of the samples	$RPD \leq 25\%$ for detections > 5 X's the DL.	Reanalyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, flag the data.
Chromatographic Resolution of CH ₄ from CO	As needed	> 50% valley	Recondition the molecular sieve column at similar levels.
Response of CO and CO ₂	As needed	< 30%	Repack the tube with fresh catalyst and allow to stabilize overnight with N ₂ flowing at 375°C.

6.11 ASTM D5504 – Sulfur Compounds

This method involves GC analysis of whole air samples collected in Silco canisters or Tedlar bags. Samples are analyzed for reduced sulfur compounds using ASTM D5504 protocols using a sulfur chemiluminescence detector (SCD).

ATL performs a modified version of this method. The modifications are detailed in the method specific SOP.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-11.1. ASTM Modified Method 5504 (Sulfur Compounds)

Analyte	DL (ppbv)	Low Point of Curve (ppbv)	Acceptance Criteria		
			ICAL (%RSD)	ISCV & CCV* (%R)	Precision (RPD)
2,5-Dimethylthiophene	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
2-Ethylthiophene	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
3-Methylthiophene	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Carbon Disulfide	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Carbonyl Sulfide	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Diethyl Disulfide	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Diethyl Sulfide	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Dimethyl Disulfide	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Dimethyl Sulfide	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Ethyl Mercaptan	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Ethyl Methyl Sulfide	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Hydrogen Sulfide	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Isobutyl Mercaptan	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Isopropyl Mercaptan	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Methyl Mercaptan	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
n-Butyl Mercaptan	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
n-Propyl Mercaptan	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
tert-Butyl Mercaptan	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Tetrahydrothiophene	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30
Thiophene	4.0	4.0 - 9.0	≤ 30	± 30	≤ 30

* Up to 10% allowed to exceed %R criterion

Table 6-11.2. Summary of Calibration and QC Procedures for Modified ASTM Method 5504

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
3 Point Calibration (ICAL)	Prior to sample analysis	%RSD \leq 30	Repeat Calibration.
Ind. Source Calibration Verification (ISCV)	With each initial calibration	\pm 30% of the expected values for at least 18 of the 20 target compounds	Check the system, re-prepare and/or reanalyze standard. Recalibrate instrument if criteria cannot be met.
Detection Limit Verification (DLV)	Each time instrument is calibrated.	\pm 50%	Check the system and reanalyze the standard. Notify QA dept. via a CAR form if the criteria cannot be met.
Laboratory Duplicates	5 % of samples	RPD \leq 30%	Perform re-analysis.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis	Full list: %R for at least 18 out of the 20 compounds w/in 70 - 130%. H2S must meet limits. Short list: %R for all compounds w/in 70% - 130%.	Check the system and re-analyze the standard. Recalibrate if criteria cannot be met.
Laboratory Blank	In between analysis of standards and project samples	Results less than the laboratory detection limit	Inspect the system and reanalyze the blank. If contamination still present, "B" flag associated sample detections.
H ₂ S - only CCV	After every five samples	Recoveries within 70% - 130%	Re-analyze the standard. Recalibrate the instrument if criteria cannot be met.
End Check	At the end of the analytical sequence.	Recoveries within 50% - 150%	Check system and reanalyze the standard. If the 2 nd analysis fails, identify and correct the problem, reanalyze a subset of the affected day's samples to determine at what point the analytical system began to fail. Perform reanalysis where necessary.
Laboratory Duplicates	5% of the samples	RPD \leq 30% for detections > 5 X's DL.	Reanalyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found with the system, flag the data.

6.12 25C/3C –Non-Methane Organic Carbon (NMOC) and Fixed Gases

This method involves GC analysis of landfill gas samples collected in Summa canisters. Samples are analyzed for NMOC as carbon by Method 25C using a flame ionization detector (FID) after an oxidation/reduction process, and for carbon dioxide, methane, nitrogen, and oxygen by Method 3C using a thermal conductivity detector (TCD).

ATL performs a modified version of this method. The modifications are detailed in the method specific SOP.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-12.1. Method 25C/3C

Analyte	Detection Limit	Low Point of Calibration Curve	Acceptance Criteria			
			ICAL	ISCV (%R)	CCV (%R)	Triplicate Injection (%RSD)*
Method 25C	ppmvC	ppmvC	%D for each level from overall mean			
NMOC	10	300	± 2.5%	± 30	± 5	≤ 5%*
Method 3C	%	%	%RSD			
Carbon Dioxide	0.10	0.10	≤ 30%	± 30	± 20	NA
Methane	0.10	0.25	≤ 30%	± 30	± 20	NA
Nitrogen	0.10	0.20	≤ 30%	± 30	± 20	NA
Oxygen	0.10	0.05	≤ 30%	± 30	± 20	NA

*Triplicate injection RSD criterion is ≤ 2% for the Method 25C initial calibration standards that are run in triplicate.

Table 6-12.2. Summary of Calibration and QC Procedures for Method 25C/3C

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Performance Test	Prior to placing system in operation, and after any major modifications	Oxidation Catalyst Efficiency: Average FID recovery of 3 methane injections < 1% of standard. Reduction Catalyst Efficiency: %D ≤ 5% for average FID methane recovery of 3 injections. Column Efficiency Performance: NMOC %D ≤ 5% for toluene, hexane, and methanol standards.	Perform system maintenance then repeat test.
Initial Calibration (Minimum of 3 levels)	Prior to Sample Analysis	3C: %RSD ≤ 30 25C (NMOC): %D ≤ 2.5% of average RF for each level from overall mean RF, and %RSD ≤ 2.0 for each triplicate injection.	Correct problem then repeat initial calibration.
Ind. Source Calibration Verification (ISCV)	With each initial calibration	± 30% of the expected value	Check the system, re-prepare and/or reanalyze the standard. Recalibrate the instrument if criteria cannot be met.
Detection Limit Verification (DLV)	Each time instrument is calibrated	± 50%	Check the system and reanalyze the standard. Notify QA dept. via a CAR form if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis	3C: %D ≤ 20% 25C: Average %D ≤ 5%, triplicate RSD ≤ 5%.	Check the system and reanalyze the standard. Repeat the Performance Test and recalibrate if criteria cannot be met.
Laboratory Blank	In between analysis of standards and project samples	Results less than the laboratory detection limit	Inspect the system and reanalyze the laboratory blank.
End Check	At the end of the analytical sequence	Same as CCV	Check system and reanalyze the standard. If the 2 nd analysis fails, identify and correct the problem, then reanalyze a subset of the affected day" samples to determine at what point the analytical system began to fail. Perform reanalysis where necessary.
Laboratory Replicates	Triplicate analysis for all NMOC (25C) injections	RSD ≤ 5%	Reanalyze the sample another time. If the limit is exceeded again,
Laboratory Duplicates	5% of 3C samples.	RPD ≤ 30% for detections > 5 times the detection limit.	investigate the cause and bring the system back to working order. If no problem is found in the system, flag the data.

6.13 GC Headspace Equilibration Technique

This method involves GC analysis of the dissolved gases in water samples collected in 40 ml VOA vials. In the laboratory, an aliquot of the sample is injected into a nitrogen-purged vial and placed into a headspace autosampler where each sample is shaken and heated prior to injection. The autosampler then injects an aliquot of

headspace onto a gas chromatographic column where the gaseous components are separated and detected by a flame ionization detector (FID). Analysis is conducted for methane, ethane, and ethylene.

The standard target analyte list, reported detection limits, QC criteria, and QC summary can be found in the following tables.

Table 6-13.1. Headspace by GC

Analyte	Detection Limit (ug/ml)	Low Point of Curve (ug/ml)	Acceptance Criteria		
			ICAL (%RSD)	ISCV & CCV (%R)	Precision (RPD)
Methane	0.01	≤ 0.027	≤ 30%	± 30	≤ 30%
Ethane	0.01	≤ 0.050	≤ 30%	± 30	≤ 30%
Ethene	0.01	≤ 0.050	≤ 30%	± 30	≤ 30%

Table 6-13.2. Summary of Calibration and QC Procedures for Headspace by GC

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Five Point Calibration (ICAL)	Prior to sample analysis.	$\%RSD \leq 30\%$	Repeat the calibration.
Ind. Source Calibration Verification (ISCV)	With each initial calibration	$\pm 30\%$ of the expected value	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Detection Limit Verification (DLV)	With each initial calibration	$\pm 50\%$ of the expected value	Check the system and reanalyze the standard. Notify the QA department via a CAR form if the criteria cannot be met.
Continuing Calibration Verification (CCV)	Daily prior to sample analysis, and after every 20 samples	$\pm 30\%$ of the expected value	Check the system and reanalyze the standard. Recalibrate the instrument if the criteria cannot be met.
Laboratory Blank	In between analysis of standards and project samples	Results less than the laboratory detection limit	Inspect the system and reanalyze the laboratory blank.
Matrix Spike	By client request	Recoveries within 70 - 130%	Check the system, rerun the standard. If criteria still not met, flag data.
Matrix Spike Duplicate	By client request	$RPD \leq 30\%$	Reanalyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found on the system, flag the data
End Check	At the end of analytical sequence	$\pm 30\%$ of the expected value	Check system and reanalyze the standard. If the 2 nd analysis fails, identify and correct the problem, then reanalyze a subset of the affected day's samples to determine at what point the analytical system began to fail. Perform reanalysis where necessary.
Laboratory Duplicates	5% of the samples	$RPD \leq 30\%$ for detections > 5 X's DL.	Reanalyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found in the system, flag the data

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7.0 DATA COLLECTION, REVIEW, REPORTING, AND RECORDKEEPING

7.1 DATA COLLECTION

Virtually all analytical results are generated from the instrument software. Following analysis, the bench chemist verifies that the computer generated data reduction is correct using the Data Review Check Sheet (see Exhibit 7.1).

7.2 DATA REVIEW

There are five categories of data review performed in the laboratory. These categories include:

- I. *Analytical review performed by the bench chemist.* This review includes a review of raw data, verification of all method and project specific QC requirements, the addition of data qualifier flags when needed, and documentation of any unusual circumstances.
- II. *Technical review performed by team leader or QA-approved peer.* This is the same type of review performed in Category I., but it is performed by a second individual.
- III. *QA review performed by a quality assurance specialist.* This review is similar to that performed by Categories I and II, but is done with an emphasis on overall quality of the data.
- IV. *Data report review by the Reporting Manager, Team Leader or approved peer.* This is a review to ensure the accuracy of the final hardcopy report.

V. *Electronic deliverable review.* This review is performed when electronic data is requested. This is a review to ensure the accuracy of the final electronic report.

Regardless of the TAT, categories I and IV (or I and V if only electronic reporting is requested) are performed on every data package. Analysts that have demonstrated proficiency can perform their own category II review. A minimum of 10% of all data packages receive category III review. A data review diagram is presented in Exhibit 7.2. Clients and projects that require the independent peer review (Category II.) to be performed by a different individual than the original analyst, even when that person is a scientist or higher, need to make that request in the project set-up stage.

7.3 DATA FLAGS

Data flags are used to clarify data reporting. Flags used by ATL include:

- "B" - Compound present in the laboratory (or media blank if applicable) blank, background subtraction not performed.
- "J" - Estimated value.
- "E" - Exceeds instrument calibration range.
- "Q" - Exceeds Quality Control Limits
- "S" - Saturated Peak
- "U" - Compound analyzed for, but not detected above the detection limit.

Definitions for the flags are also provided in the body of the report.

7.4 FINAL REPORT PRODUCTION

Data reports are created using one of the following systems.

7.4.1 Automatic Data Transfer System (ADT)

Data reports are created using the ADT system. This system automatically transfers analytical results to a database. After any hand-calculated results such as NMOC or TPH values are added, all data are reviewed to ensure accuracy. The results are then compiled into a Work Order report using an automated reporting tool. The work order report is reviewed using the data reporting checklists (Exhibit 7.3).

7.4.2 Manual Data Entry

Results that cannot be reported using the ADT system are manually entered into a validated, pre-programmed spreadsheet. The data is thoroughly reviewed for accuracy using the check sheet in Exhibit 7.4.

Data reports are designed to include all necessary information which would be required for traceability including:

- Analytical laboratory name, address, and phone number
- Project name or number
- Sample field I.D. number
- Laboratory I.D. number
- Receipt pressure or temperature (noted on Chain of Custody)
- Date of Collection
- Date of Extraction (if applicable)
- Date of Analysis

- Applicable method reference
- Instrument number
- Analytical run file name
- Analyte list
- Dilution factor
- Detection Limit
- Amount detected in units specified
- Surrogate percent recovery
- Laboratory Director signature
- Chain of Custody Record

All final reports are signed by the Laboratory Director or an appropriate designee after all QC results have been reviewed and any deviations from the acceptance criteria are noted in the Laboratory Narrative section of the report.

7.5 ELECTRONIC DATA REVIEW

Electronic data is reviewed for accuracy using the checklists found in Exhibits 7.5a & 7.5b.

7.6 RECORDS OF METHOD CAPABILITY

The multi-point calibrations, MDL studies and detection limit verifications serve as documentation of our method capability.

7.7 DATA STORAGE

The laboratory maintains electronic and hardcopy reports, as well as all supporting information including calibrations, MDL studies, detection limit verifications, logbooks and SOPs for a minimum of 10 years.

7.8 CONFIDENTIALITY OF DATA

The data generated by analyzing a client's samples is considered to be that client's proprietary property. Accordingly, that data is treated as confidential information and released only to that client, as identified by associated contractual agreements unless written permission is given to proceed otherwise.

EXHIBIT 7.1 – DATA REVIEW CHECK SHEET

R	A	T	Q	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CLP Narrative required
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Corrective Action issued - # _____
<input type="checkbox"/>				Sample Discrepancy Report issued
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Unusual Circumstances have been Documented in notes section
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Appropriate Initial Curve Info. Present
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The Dilution Factor was Correctly Calculated
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Correct Amount of Sample Analyzed
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Surrogates, I.S., CO ₂ peak, System peak are identified in chromatogram
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Retention Times have been Verified
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Peak Area Integration Correct
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spectra Verified - Documentation of Difficult Calls Included
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Transcriptions have been Checked
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Appropriate Data Qualifier Flags were Used
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Checked Samples for Trends
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Checked the C.O.C. for Field Blanks and Dups.
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The Data Sheets have the Correct Reporting Limits, Units, Header Info.
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Hold time is met for all samples
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12 hours clock verification (when required by the project)
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is the package compiled correctly?
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are samples pressurized with the appropriate gas? (if applicable)
		<input type="checkbox"/>	<input type="checkbox"/>	The Final Report Cover Sheet is Correct
		<input type="checkbox"/>	<input type="checkbox"/>	The Reporting Limits for all samples in the final report are correct
		<input type="checkbox"/>	<input type="checkbox"/>	Special Units for all samples in the final report were correctly calculated
		<input type="checkbox"/>	<input type="checkbox"/>	Results manually entered into the final report are correct.
		<input type="checkbox"/>	<input type="checkbox"/>	Data Validatable package / CLP Package is correct
		<input type="checkbox"/>	<input type="checkbox"/>	Final narrative is correct

Notes: (to include: noting samples with QA/QC problems, blanks with positive hits, narratives, etc.)

Sample Receiving/Date

Analytical Review/Date

Technical Review/Date

QA Review/Date

EXHIBIT 7.2 – DATA FLOW DIAGRAM

Category I

Bench chemist

1. Check for any project-specific requirements.
2. Verify holding time.
3. Verify the tuning criteria, CCV, LCS (when applicable) and end check (when applicable).
4. Verify method blank has no hits above detection limit.
5. Verify sample results.
 - a. Verify that internal standard, retention time and surrogate recoveries are acceptable.
 - b. Verify correct amount of sample analyzed.
 - c. Verify computer peak integrations and spectra identification are correct.
 - d. Verify result concentrations are within linear range of calibration curve (upper 50% for dilutions.)
6. Initial and date raw data/and or log book entry to indicate that the data is acceptable.
7. Apply appropriate data flags.
8. Describe unusual events on data review sheet.

Categories II and III

Team Leader / Approved Peer and QA Review:

Review steps 1 - 8 listed in Category I.

Category IV

Team Leader / Report Generation

Review final report (reporting limits, special units, results, etc).

Category V

Report Generation

Electronic data review (performed when electronic data is requested).

EXHIBIT 7.3a – CLP / ADT CHECKLIST (TEAM A) REPORT ANALYST

- ☐ Green Sheet checked for any unusual circumstances and noted on the WO if necessary.
- ☐ Sample names in headers exactly match IDs on login.
- ☐ WO Summary/Cover Page reflects the correct number of Blanks (named VBLK01, ...etc for CLP)
- ☐ WO Summary/Cover Page reflects the correct Duplicate samples (named ...-DUP for CLP).
- ☐ TPH or TNMHC are referenced to the compound reflected in the login.
- ☐ The list has the same compounds as the login.
- ☐ The detection limits are the same as the login.
- ☐ Lab Blanks are in chronological order.
- ☐ There is a Lab Blank for every clock on the WO.
- ☐ There is 100% Method Spike per client's request (no Method Spike reported for CLP!)
- ☐ The samples are in the correct order.
- ☐ All applicable narratives or notes are reflected in the proper place on the WO.
- ☐ Sample dates are correct for all samples.
- ☐ Container types are correct for all samples.

For CLP only:

- ☐ Sample volumes are correct.
- ☐ The correct type of analysis is listed in the header for CLP.
- ☐ All changes are made in ATLAS '97 for CLP.
- ☐ Re-check the edited flags for CLP.

Reviewed by _____ Date: _____

LAB SCIENTIST

- | | |
|--|---|
| <ul style="list-style-type: none"> <input type="checkbox"/> Lab Narrative is included. <input type="checkbox"/> All Flags are correct. <input type="checkbox"/> Duplicates match. <input type="checkbox"/> OK for FAX/Finals | <ul style="list-style-type: none"> <input type="checkbox"/> Detection Limits are correct for all samples. <input type="checkbox"/> TICs are correct for all samples. <input type="checkbox"/> Technical Review is completed. <input type="checkbox"/> Please make changes, then OK for FAX/Finals |
|--|---|

Explain: _____

☐ Changes made OK to FAX/Final

Changes made by: _____ Date: _____

Reviewed by: _____ Date: _____

NOTE: Complete each box with a "X" for completed or "NA" for Not Applicable. No box is to be left empty!

EXHIBIT 7.3b – CLP / ADT CHECKLIST (TEAM B)
REPORT ANALYST

- ☐ Green Sheet checked for any unusual circumstances and noted on the WO if necessary.
- ☐ Sample names in headers exactly match IDs on login.
- ☐ WO Summary/Cover Page reflects the correct number of Blanks (named "Lab Blank" for ADT).
- ☐ WO Summary/Cover Page reflects the correct Duplicate samples (named ...-DUP for CLP).
- ☐ TPH & C2-C4 Hydrocarbons are referenced to the compound reflected in the login.
- ☐ The list has the same compounds as the login.
- ☐ The detection limits are the same as the login.
- ☐ Lab Blanks are in chronological order.
- ☐ There is a Lab Blank for every clock on the WO.
- ☐ There is a Method Spike for duplicate run on the WO.
- ☐ There is a LCS for all extracted samples with or without duplicates.
- ☐ All Lab Blanks are named appropriately for CLP.
- ☐ The samples are in the correct order.
- ☐ All applicable narratives or notes are reflected in the proper place on the Data pages/WO Summary page.
- ☐ Sample/collection dates are correct for all samples matching the dates on the login.
- ☐ Container types are correct for all samples.

Reviewed by: _____ Date: _____

LAB SCIENTIST

- | | |
|---|--|
| <input type="checkbox"/> Lab Narrative is included. | <input type="checkbox"/> Detection Limits are correct for all samples. |
| <input type="checkbox"/> All Flags are correct. | <input type="checkbox"/> TICs are correct for all samples. |
| <input type="checkbox"/> Technical Review is completed. | |
| <input type="checkbox"/> OK for FAX/Finals | <input type="checkbox"/> Please make changes, then OK for FAX/Finals |

Explain:

☐ Changes made OK to FAX/Final

Changes made by: _____ Date: _____

Reviewed by: _____ Date: _____

NOTE: Complete each box with a "X" for completed or "NA" for Not Applicable. No box is to be left empty!

EXHIBIT 7.4 – EXCEL DATA ENTRY / CLP CHECKLIST REPORT ANALYST

- ☐ Green Sheet checked for any unusual circumstances and noted on the WO.
- ☐ Login Sheet checked for any changes by the lab and proper changes made.
- ☐ Dilution Factors have the correct number of sig. figs. (i.e. 3 sig. figs. for can/bag or 2 sig. figs. for any other container type).
- ☐ File name is correct.
- ☐ Date of analysis is correct (2 spaces past the colon, the date is in m/dd/yy format).
- ☐ Detection Limits change correctly with the Dilution Factor and are reported with 2 sig. figs.
- ☐ Results reported are at or above the reporting limit (unless they are reported with a "J" flag).
- ☐ All results are reported with 2 sig. figs.
- ☐ All data qualifiers used to report sample results are defined at the end of the data page.
- ☐ If the results are reported with special units, 2 results were hand calculated to verify the formulas within the spreadsheet. (Check results from 2 different samples and for different compounds).
- ☐ Results are reported in the correct units (check raw data versus data sheet).
- ☐ Units are %Rec for Method Spikes & LCSs.
- ☐ WO Summary Page reflects the correct Duplicate samples, duplicate sample is designated as <Sample Name> "Duplicate", and reported at no charge (NC).
- ☐ A Method Spike is included in report and Summary Page if there is a duplicate or if the client is on the list of clients who always get a Method Spike.
- ☐ LCS is included if the samples are extracted.
- ☐ There is a Lab Blank for every clock on the WO.
- ☐ All applicable narratives or notes are reflected in the proper place on the WO.

Reviewed by: _____ Date: _____

LAB SCIENTIST

- | | |
|--|--|
| <ul style="list-style-type: none"> <input type="checkbox"/> Lab Narrative is included. <input type="checkbox"/> All Flags are correct. <input type="checkbox"/> Duplicates match. <input type="checkbox"/> Results reported as intended. <input type="checkbox"/> OK for FAX/Finals | <ul style="list-style-type: none"> <input type="checkbox"/> Detection Limits are correct for all samples. <input type="checkbox"/> TIC's are correct for all samples. <input type="checkbox"/> Technical Review is completed. <input type="checkbox"/> Please make changes, then OK for FAX/Finals |
|--|--|

Explain:

☐ Changes made OK to FAX/Final

Changes made by: _____ Date: _____

Reviewed by: _____ Date: _____

NOTE: Complete each box with a "X" for completed or "NA" for Not Applicable. No box is to be left empty!

Revision Date: 05/10/99

EXHIBIT 7.5a – DISK REVIEW CHECKLIST

A PR

Work Order # :

--

- ☐ ☐ Correct File Format
- ☐ ☐ Correct Sample ID's
- ☐ ☐ All Samples Included
- ☐ ☐ Significant Figures Correct
- ☐ ☐ Correct Field Alignment
- ☐ ☐ Correct Units
- ☐ ☐ Data Entry is Accurate
- ☐ ☐ Correct Detection Limits
- ☐ ☐ RPD Correctly calculated (if applicable)
- ☐ ☐ Correct Client Format
- ☐ ☐ Rounding Function
- ☐ ☐ If the file was saved as "space delimited", at least 2 column widths were checked.
(DO NOT pull up space delimited in EXCEL!).

Data Analyst Review / Date

Peer Review / Date

EXHIBIT 7.5b – EXCEL DISK REVIEW CHECK SHEET

A PR

Workorder #:

--

- ☐ ☐ All fields are accounted for and are linking the correct type of information
(Checked against format from disk book)
- ☐ ☐ All client and lab IDs are correct.
- ☐ ☐ The correct list was used.
- ☐ ☐ All dates and times are correct (Received date blank for QC unless client requests otherwise).
- ☐ ☐ Dilution Factors are correct.
- ☐ ☐ Reporting Limits are correct.
- ☐ ☐ File links to the correct MDL.
- ☐ ☐ All hits are correct.
- ☐ ☐ All units are correct.
- ☐ ☐ All flags needed for the client are present.
- ☐ ☐ All samples are included.
- ☐ ☐ Significant figures are correct for the format.
- ☐ ☐ Data entry is accurate.
- ☐ ☐ All fields on disk have the correct information.
- ☐ ☐ The file was saved in the correct format with the correct extension and file was pulled up in the appropriate program to ensure it came over correctly.
- ☐ ☐ If the file was saved as "space delimited", at least 2 column widths were checked.
(DO NOT pull up space delimited in EXCEL!).
- ☐ ☐ The file was put through appropriate EDD Checker (if applicable).

Data Analyst Review/ Date

Peer Review/ Date

- NOTE:**
1. Never save over a template. If a change to the template is necessary, document what changes were made, date and initial.
 2. Avoid saving over links whenever possible.
 3. Document any changes that a client requests both in the disk book and in the README file.
 4. Communicate problems and changes.

Revision Date: 05/10/99

8.0 ESTABLISHING ACCEPTANCE CRITERIA

Acceptance criteria for QC results are established using historical limits based on the published methods noted in Section 1.0 of this Quality Manual. The criteria for our most commonly-performed methods are noted in Section 6.0. When clients require project-specific QC acceptance criteria that differ from our normal protocol, this information is communicated to the laboratory personnel using the project profiles described in Section 3.5.

As an additional means of monitoring analytical performance, instrument-specific control charts are developed for surrogate recoveries and LCS recoveries.

The control charts are developed from a minimum of 20 data points, and are updated quarterly. The calculations used to establish and update these investigative limits are as follows:

$$\begin{aligned}\text{Upper Limit} &= M + 3S, \text{ and} \\ \text{Lower Limit} &= M - 3S.\end{aligned}$$

Where,

- M: The population mean recovery of at least 20 points, and
S: The standard deviation of the population.

The QA department investigates the instrument performance whenever one of the following four conditions is observed:

- Three consecutive points are outside of the warning limits;
- Eight consecutive points are on the same side of the mean;
- Six consecutive points such that each point is larger (smaller) than its immediate predecessor; or,
- The presence of any obvious cyclical pattern.

The investigation could include:

- Check standards
- Check calibration
- Check calculations
- Verify instrument performance by running a check Sample
- Re-calibrate the instrument

The team leaders are informed of any trends or biases in the weekly QA meetings. However, no corrective steps are taken until the system exceeds the method-established (i.e., historical) acceptance criteria.

Additional information about our control-charting procedures are described in our SOP #48.

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9.0 PREVENTIVE MAINTENANCE

Preventive maintenance consists of an on-going program of routine maintenance, service contracts and a comprehensive inventory of spare parts. The program is designed to adequately protect the laboratory from unexpected instrument down time.

9.1 ROUTINE MAINTENANCE

Instruments are monitored on a daily basis by the bench analyst for potential failure. The analysis of blanks and control standards at the start of the day and as analysis continues helps to provide real time feedback to the analyst on the condition of the instruments. Routine maintenance specific to the various types of instruments is covered in the method SOPs.

Any routine or major maintenance is documented in the bound maintenance log book assigned to each instrument. The date of the maintenance, what work was performed and analyst's initials are included.

If a malfunction occurs and control of the analytical system cannot be demonstrated using the QC parameters discussed in section 4.3, the instrument is removed from production until analytical control can again be demonstrated.

9.2 SERVICE CONTRACTS

Analytical systems are covered under manufacturer service agreements. These agreements cover all forms of hardware failure and include regular hardware upgrades as needed. The response time is guaranteed to be within 48 hours under the agreement and includes parts and labor.

Some contracts cover regularly scheduled routine maintenance. Leased instrumentation is similarly covered by service agreements either through the leasing agency or directly with the manufacturer.

In addition, the Methods Development group performs biannual (every six months) preventative maintenance on the mass spectrometers. Records of this are kept in the individual instrument's maintenance log books.

9.3 SPARE PARTS INVENTORY

A normal inventory of consumable parts most frequently required is maintained in the laboratory. These parts are typically not covered by the service agreements and may take several weeks to acquire on an as needed basis. An inventory of these parts is required to minimize instrument down time and facilitate routine maintenance.

9.4 CONTROL OF MISCELLANEOUS MONITORING, MEASURING, TESTING AND DATA COLLECTION EQUIPMENT

In addition to the equipment used directly in the analysis of samples, ATL uses various other monitoring, measuring, testing and data collection equipment. This equipment includes: pressure gauges, fume hood testing devices, thermometers and sampling interface flow controllers. Our procedures for ensuring the accuracy of our test equipment are summarized in the following sections. Additional information can be found in our Certification of Test Equipment SOP, # 34, and our Refrigerator and Freezer Temperature Monitoring SOP # 19.

9.4.1 PRESSURE GAUGES

Pressure gauges are used to verify sample receipt pressures and for gaseous standard preparation. The measurement of pressure on the gauges used to pressurize Summa canisters is relative. The readings are used to assess the initial canister receipt vacuum/pressure and then pressurize the canister to a known pressure. The receiving personnel compare the final vacuum/pressure recorded on the Chain-of-Custody Record and/or sample tags by the field personnel with the receipt vacuum/pressure. If there is a discrepancy of more than 5"Hg/5psi a sample discrepancy report (Exhibit 5.3) is initiated and the client is notified.

The accuracy of the sample pressurization system is verified weekly using a NIST-certifiable digital pressure gauge which is accurate within $\pm 2\%$ of the reading. Both the vacuum reading ("Hg) and positive pressure (psi) will be checked to ensure the system is accurate within $\pm 10\%$ or within laboratory-established control limits, whichever are narrower. If a pressurization manifold is found to be inaccurate, it will be serviced or replaced prior to pressurizing any samples.

Annually the NIST-certifiable pressure gauge is returned to the manufacturer for certification. NIST traceability and corrections are recorded on the certificate. The certificate is maintained in the Quality Assurance Department.

9.4.2 FUME HOOD TESTING DEVICE

Quarterly, a hot wire anemometer is used to check fume hood velocities. The certificate of calibration indicating NIST traceability and tolerances is kept by the QA Department. The anemometer is returned to the manufacturer for certification every two years. NIST traceability and corrections are recorded on the certificate.

9.4.3 THERMOMETERS

NIST certified thermometers are purchased annually. The certificates are maintained in the Quality Assurance Department. Thermometers are used twice daily to check the temperatures of sample storage refrigerators and the neat standard storage freezers. A NIST-traceable thermometer is also used to check the receipt temperature of samples that are required to be preserved at less than ambient temperature.

The refrigerators are maintained at $4 \pm 2^\circ\text{C}$, and the freezers at $-18 \pm 4^\circ\text{C}$. If a refrigerator or freezer temperature is found to be one degree higher than or more than 2 degrees lower than the acceptance limits, an adjustment is made to the thermostat. If in the subsequent check the trend continues, or if larger variations are noted, a corrective action request (CAR) form is generated. The CAR system ensures that the QA department, lab management, and clients are all informed of the deviation so that appropriate action can be taken.

9.4.4 FLOW CONTROLLERS

Because the mass flow controllers on the sampling interfaces are used to as part of the initial calibration, the measurements made using them are relative in nature. The samples are introduced through the very same process, therefore any potential bias is self-correcting. In addition, the accuracy of the mass flow controllers is verified in three ways:

- 1) Each time the daily CCV is analyzed, the recoveries document the accuracy of the mass flow controller with respect to the most recent instrument calibration.
- 2) The linearity of the calibration curve demonstrates the accuracy of the mass

flow controller because the curve is developed using a mix of syringe dilutions and introducing the standards through the flow controller.

- 3) Through comparison of the new calibration curve with the previous curve, the accuracy of the mass flow controller is verified.

In addition, the mass flow controllers on the sampling interfaces are sent to the manufacturer for biennial (every 2 years) calibration. They are returned with a dated label to ensure calibration is performed at the proper frequency. The Methods Development group oversees the mass flow controller certification program.

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10.0 SYSTEM AUDITS AND PERFORMANCE EVALUATIONS SAMPLES

System audits are conducted and performance evaluation samples are submitted by various certifying agencies, private clients, and ATL's QA department.

Results from audits, performance evaluation samples, and any ensuing corrective actions are noted in the weekly QA meetings with management. In addition, a **Quarterly QA Report** which summarize the status of any outstanding CARs, results from any PE samples, internal and external audit findings, and any general QA issues is distributed throughout ATL, and kept on file in the Quality Assurance Department.

10.1 SYSTEM AUDITS

Audits generally include a qualitative review of the overall analytical system.

10.1.1 External System Audits are those conducted by organizations such as the State and other certifying agencies, and by private clients.

10.1.2 Internal System Audits are performed by the ATL QA department on an annual basis. Our internal auditing procedure is described in SOP #27.

10.2 PERFORMANCE EVALUATION (PE) SAMPLES

Performance evaluation samples are used to measure analytical accuracy, precision and report completeness. Performance samples are throughout the laboratory in the same manner as project samples. No additional measures are taken in the analysis of PE samples.

10.2.1 External PE Samples are submitted, single blind, by organizations such as the State and other certifying agencies, and by private clients. The PE samples submitted by certifying agencies include inter-laboratory comparisons.

10.2.2 Internal PE Samples are project samples that are resubmitted by the QA department for blind duplicate analysis. Internal PE samples have previously been submitted for Methods TO-14 and TO-3. Internal PE samples will be submitted for Methods TO-14, TO-3, TO-13, ASTM D1946, ASTM 5504, and Method 25C a minimum of two times per year beginning in 1999.

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11.0 MANAGEMENT OF COMPUTER AND SOFTWARE SYSTEMS

11.1 SECURITY

The security of Air Toxic Ltd's computer hardware and electronic data is managed via a system of passwords for each employee. Each individual's name and password allow him or her access only to those work areas that they are involved in.

11.2 BACK-UPS & STORAGE OF DATA

All electronic data, including project management files, analytical data, audit trails, and quality assurance documents are backed up on a daily, weekly, and monthly basis. The monthly backup tapes are stored in an offsite facility for a minimum of 10 years.

Archival procedures for analytical instrument and HP ChemServer, daily,

weekly, and monthly backup procedures for the HP ChemServer, storage of the backup tapes, and a log of the back up procedures are detailed in ATL's SOP #55, *Electronic Archival of GC/MS Analytical Instrument Data*.

11.3 SOFTWARE & ELECTRONIC DATA VALIDATION

The various testing stages and process for implementation of internally developed software are described in ATL's SOP # 47, *Implementation and Testing of Atlas Modules*.

Preparation Of Hardcopy Analytical Reports Using Automated Data Transfer, ATL's SOP #41, and *Electronic Deliverable Generation And Review*, ATL's SOP #23 describe the procedures used to create and validate electronic data reduction.

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12.0 CONTROL OF PURCHASED ITEMS AND EXTERNAL SERVICES

The primary materials procured by the laboratory are computer hardware and standard office software, analytical instrumentation, certified standards, carrier gases and cryogens, miscellaneous laboratory supplies, NIST-traceable re-certifications, disposable sampling media (e.g., Tedlar bags) and service contracts.

Control of the purchase of these items and services is maintained using a standard purchase order system that includes the following:

- A purchase request that is approved by a director or manager.
- An assigned purchase order (PO) number that is logged along with the date, vendor, and requester.
- A requirement that upon receipt or delivery of services, the product is inspected by the original requestor, and compared to the packing slip and/or request for services. Approval of the condition, quality, and quantity the item/service received is documented by the original requestor's initials and date on the packing slip or request for services. A PO is not closed until this step is performed.
- PO's are matched with invoices prior to payment to insure purchased items or services were delivered as expected.

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APPENDICES

Appendix A – Chemical Abstracts Registry Numbers (CAS #'s)

Appendix B – List of Standard Operating Procedures (SOPs)

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Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
7667-55-2	(1-alpha,2-alpha,3-beta)-1,2,3-Trimethylcyclohexane
98-83-9	(1-Methylethenyl)benzene (alpha Methyl Styrene)
768-49-0	(2-Methyl-1-propenyl)benzene
7283-47-8	(3,3-Dimethyl-1-methylenebutyl)benzene
624-64-6	(E)-2-Butene
74630-52-7	(E)-6-Methyl-3-undecene
10482-56-1	(S)-alpha,alpha,4-Trimethyl-3-cyclohexene-1-methanol
821-97-6	(Z)-3-Undecene
1075-38-3	1-(1,1-Dimethylethyl)-3-methylbenzene
20324-32-7	1-(2-Methoxy-1-methylethoxy)-2-propanol
630-20-6	1,1,1,2-Tetrachloroethane
71-55-6	1,1,1-Trichloroethane
354-58-5	1,1,1-Trichlorotrifluoroethane
79-34-5	1,1,2,2-Tetrachloroethane
79-00-5	1,1,2-Trichloroethane
16596-38-6	1,1-Bis-(2-methylpropyl) Hydrazine
471-43-2	1,1-Dichloro-2,2-difluoroethane
75-34-3	1,1-Dichloroethane
75-35-4	1,1-Dichloroethene
563-58-6	1,1-Dichloropropene
75-37-6	1,1-Difluoroethane
68998-21-0	1,1-Dimethyl-2-(3-methyl-1,3-butadienyl)-cyclopropane
354-21-2	1,2,2-Trichloro-1,1-difluoroethane
634-66-2	1,2,3,4-Tetrachlorobenzene
488-23-3	1,2,3,4-Tetramethylbenzene
87-61-6	1,2,3-Trichlorobenzene
96-18-4	1,2,3-Trichloropropane
526-73-8	1,2,3-Trimethylbenzene
95-94-3	1,2,4,5-Tetrachlorobenzene
120-82-1	1,2,4-Trichlorobenzene
95-63-6	1,2,4-Trimethylbenzene
3711-38-4	1,2-Bis-(1-methylpropyl) Hydrazine
96-12-8	1,2-Dibromo-3-chloropropane
430-57-9	1,2-Dichloro-1-fluoroethane
95-50-1	1,2-Dichlorobenzene
107-06-2	1,2-Dichloroethane
17060-07-0	1,2-Dichloroethane-d4
623-46-1	1,2-Dichloroethyl Ethyl Ether
78-87-5	1,2-Dichloropropane
135-01-3	1,2-Diethylbenzene
573-98-8	1,2-Dimethylnaphthalene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
122-66-7	1,2-Diphenylhydrazine
106-88-7	1,2-Epoxybutane
629-20-9	1,3,5,7-Cyclooctatetraene
108-70-3	1,3,5-Trichlorobenzene
102-25-0	1,3,5-Triethylbenzene
108-67-8	1,3,5-Trimethylbenzene
106-99-0	1,3-Butadiene
541-73-1	1,3-Dichlorobenzene
142-28-9	1,3-Dichloropropane
141-93-5	1,3-Diethylbenzene
99-62-7	1,3-Diisopropylbenzene
575-41-7	1,3-Dimethylnaphthalene
99-65-0	1,3-Dinitrobenzene
646-06-0	1,3-Dioxolane
623-27-8	1,4-Benzenedicarboxyaldehyde
106-46-7	1,4-Dichlorobenzene
3855-82-1	1,4-Dichlorobenzene-d4
105-05-5	1,4-Diethylbenzene
540-36-3	1,4-Difluorobenzene
123-91-1	1,4-Dioxane
571-61-9	1,5-Dimethylnaphthalene
575-43-9	1,6-Dimethylnaphthalene
464-17-5	1,7,7-Trimethylbicyclo[2.2.1]hept-2-ene
569-41-5	1,8-Dimethylnaphthalene
22370-55-4	10-Methyl-1-undecene
1072-85-1	1-Bromo-2-fluorobenzene
106-94-5	1-Bromopropane
106-98-9	1-Butene
513-36-0	1-Chloro-2-methylpropane
90-13-1	1-Chloronaphthalene
872-05-9	1-Decene
4926-90-3	1-Ethyl-1-methylcyclohexane
874-41-9	1-Ethyl-2,4-dimethylbenzene
74663-86-8	1-Ethyl-2-heptylcyclopropane
62238-33-9	1-Ethyl-2-propylcyclohexane
4938-52-7	1-Hepten-3-ol
592-76-7	1-Heptene
111-27-3	1-Hexanol
592-41-6	1-Hexene
73105-67-6	1-Iodo-2-methylundecane
4292-19-7	1-Iodododecane

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
107-98-2	1-Methoxy-2-propanol
140-67-0	1-Methoxy-4-(2-propenyl)benzene
767-59-9	1-Methyl-1H-indene
90-12-0	1-Methylnaphthalene
38072-94-5	1-Methylnaphthalene-d10
90-15-3	1-Naphthol
124-11-8	1-Nonene
111-66-0	1-Octene
109-67-1	1-Pentene
10487-96-4	1-Phenylcyclopentanol
71-23-8	1-Propanol
1745-81-9	2-(2-Propenyl)phenol
13475-81-5	2,2,3,3-Tetramethylhexane
25414-22-6	2,2,3-Trimethyl-1-butene
62338-09-4	2,2,3-Trimethyldecane
13475-82-6	2,2,4,6,6-Pentamethylheptane
62237-98-3	2,2,4-Trimethyldecane
14720-74-2	2,2,4-Trimethylheptane
16747-26-5	2,2,4-Trimethylhexane
62016-28-8	2,2,6-Trimethyloctane
594-20-7	2,2-Dichloropropane
75-83-2	2,2-Dimethylbutane
17302-37-3	2,2-Dimethyldecane
1071-26-7	2,2-Dimethylheptane
17312-64-0	2,2-Dimethylundecane
16747-28-7	2,3,3-Trimethylhexane
560-21-4	2,3,3-Trimethylpentane
58-90-2	2,3,4,6-Tetrachlorophenol
921-47-1	2,3,4-Trimethylhexane
565-75-3	2,3,4-Trimethylpentane
62238-11-3	2,3,5-Trimethyldecane
2245-38-7	2,3,5-Trimethylnaphthalene
697-82-5	2,3,5-Trimethylphenol
85-34-7	2,3,6-Trichlorophenylacetic Acid
62238-12-4	2,3,6-Trimethyldecane
271-89-6	2,3-Benzofuran
7145-20-2	2,3-Dimethyl-2-hexene
581-40-8	2,3-Dimethylnaphthalene
565-59-3	2,3-Dimethylpentane
526-75-0	2,3-Dimethylphenol
107-39-1	2,4,4-Trimethyl-1-pentene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
877-09-8	2,4,5,6-Tetrachloro-m-xylene
95-95-4	2,4,5-Trichlorophenol
118-79-6	2,4,6-Tribromophenol
88-06-2	2,4,6-Trichlorophenol
527-60-6	2,4,6-Trimethylphenol
95-80-7	2,4-Diaminotoluene
320-60-5	2,4-Dichloro-1-(trifluoromethyl)benzene
120-83-2	2,4-Dichlorophenol
2213-23-2	2,4-Dimethylheptane
108-08-7	2,4-Dimethylpentane
105-67-9	2,4-Dimethylphenol
17312-80-0	2,4-Dimethylundecane
51-28-5	2,4-Dinitrophenol
121-14-2	2,4-Dinitrotoluene
123-54-6	2,4-Pentanedione
29548-02-5	2,5,5-Trimethyl-1,3,6-heptatriene
62108-23-0	2,5,6-Trimethyldecane
62108-22-9	2,5,9-Trimethyldecane
1708-29-8	2,5-Dihydrofuran
74663-83-5	2,5-Dimethyl-3-methylene-1,5-heptadiene
5779-94-2	2,5-Dimethylbenzaldehyde
592-13-2	2,5-Dimethylhexane
95-87-4	2,5-Dimethylphenol
638-02-8	2,5-Dimethylthiophene
18344-37-1	2,6,10,14-Tetramethylheptadecane
31295-56-4	2,6,11-Trimethyldodecane
62108-25-2	2,6,7-Trimethyldecane
581-42-0	2,6-Dimethylnaphthalene
17302-28-2	2,6-Dimethylnonane
75163-97-2	2,6-Dimethyloctadecane
2051-30-1	2,6-Dimethyloctane
576-26-1	2,6-Dimethylphenol
17301-23-4	2,6-Dimethylundecane
606-20-2	2,6-Dinitrotoluene
91-08-7	2,6-Toluene Diisocyanate
74645-98-0	2,7,10-Trimethyldodecane
582-16-1	2,7-Dimethylnaphthalene
17301-25-6	2,8-Dimethylundecane
15892-23-6	2-Butanol
78-93-3	2-Butanone (Methyl Ethyl Ketone)
107-01-7	2-Butene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
10487-71-5	2-Butenoylchloride
111-76-2	2-Butoxyethanol
112-07-2	2-Butoxyethyl Acetate
532-27-4	2-Chloroacetophenone
95-51-2	2-Chloroaniline
110-75-8	2-Chloroethyl Vinyl Ether
91-58-7	2-Chloronaphthalene
95-57-8	2-Chlorophenol
75-29-6	2-Chloropropane
95-49-8	2-Chlorotoluene
110-80-5	2-Ethoxy Ethanol
1758-88-9	2-Ethyl-1,4-dimethyl benzene
104-76-7	2-Ethyl-1-hexanol
20627-54-7	2-Ethyl-5-methyl-1,3-dioxane
13925-03-6	2-Ethyl-6-methylpyrazine
123-05-7	2-Ethylhexanal
1613-52-1	2-Ethylthiacyclohexane
872-55-9	2-Ethylthiophene
611-14-3	2-Ethyltoluene
321-60-8	2-Fluorobiphenyl
367-12-4	2-Fluorophenol
591-78-6	2-Hexanone
20265-35-4	2-Methoxy-3-nitropyridine
109-86-4	2-Methoxyethanol
137-32-6	2-Methyl-1-butanol
763-29-1	2-Methyl-1-pentene
534-22-5	2-Methylfuran
591-76-4	2-Methylhexane
91-57-6	2-Methylnaphthalene
871-83-0	2-Methylnonane
3221-61-2	2-Methyloctane
107-83-5	2-Methylpentane
95-48-7	2-Methylphenol (o-Cresol)
91-59-8	2-Naphthylamine
88-74-4	2-Nitroaniline
88-75-5	2-Nitrophenol
79-46-9	2-Nitropropane
4057-42-5	2-Octene, 2,6-dimethyl-
6032-29-7	2-Pentanol
107-87-9	2-Pentanone
53907-59-8	2-Pentene, 3-ethyl-4,4-dimethyl-

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
67-63-0	2-Propanol
141-32-2	2-Propenoic Acid Butyl Ester
2499-59-4	2-Propenoic acid, octyl ester
10042-59-8	2-Propyl-1-heptanol
2295-35-4	2-Pyrrolidinethione
34004-69-8	3(2H)-Furanone, dihydro-5-isopropyl-
49622-18-6	3,3,4-Trimethyldecane
7154-80-5	3,3,5-Trimethylheptane
91-94-1	3,3'-Dichlorobenzidine
53941-19-8	3,4,4-Trimethyl-2-hexene
583-48-2	3,4-Dimethylhexane
95-65-8	3,4-Dimethylphenol
108-68-9	3,5-Dimethylphenol
17312-53-7	3,6-Dimethyldecane
17302-32-8	3,7-Dimethylnonane
26472-00-4	3a,4,7,7a-Tetrahydro-4,7-methano-1H-indene
13466-78-9	3-Carene
107-05-1	3-Chloropropene
16789-46-1	3-Ethyl-2-methylhexane
52896-90-9	3-Ethyl-5-methylheptane
620-14-4	3-Ethyltoluene
106-35-4	3-Heptanone
563-80-4	3-Methyl-2-butanone
15726-15-5	3-Methyl-4-heptanone
31081-18-2	3-Methyl-5-propylnonane
13151-34-3	3-Methyldecane
589-34-4	3-Methylhexane
96-14-0	3-Methylpentane
108-39-4	3-Methylphenol
100-80-1	3-Methylstyrene
616-44-4	3-Methylthiophene
6418-41-3	3-Methyltridecane
1002-43-3	3-Methylundecane
99-09-2	3-Nitroaniline
106-68-3	3-Octanone
100-10-7	4-(Dimethylamino)benzaldehyde
55702-61-9	4,4,5-Trimethyl-2-hexane
72-54-8	4,4-DDD
72-55-9	4,4-DDE
50-29-3	4,4-DDT
72-43-5	4,4-Methoxychlor

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
54410-98-9	4,6,8-Trimethyl-1-nonene
616-55-7	4,6-Di(1,1-dimethylethyl)-2-methylphenol
534-52-1	4,6-Dinitro-2-methylphenol
554-01-8	4-Amino-5-methyl-2(1H)-pyrimidinone
92-67-1	4-Aminobiphenyl
460-00-4	4-Bromofluorobenzene
101-55-3	4-Bromophenyl-phenyl Ether
59-50-7	4-Chloro-3-methylphenol
106-47-8	4-Chloroaniline
7005-72-3	4-Chlorophenyl-phenyl Ether
106-43-4	4-Chlorotoluene
6203-18-5	4-Dimethylaminocinnamaldehyde
934-80-5	4-Ethyl-1,2-dimethylbenzene
62108-31-0	4-Ethyl-2,2,6,6-tetramethylheptane
4748-78-1	4-Ethylbenzaldehyde
622-96-8	4-Ethyltoluene
99-96-7	4-Hydroxybenzoic Acid
108-10-1	4-Methyl-2-pentanone
2847-72-5	4-Methyldecane
99-84-3	4-Methylene-1-(1-methylethyl)cyclohexene
589-53-7	4-Methylheptane
17301-94-9	4-Methylnonane
106-44-5	4-Methylphenol
100-01-6	4-Nitroaniline
100-02-7	4-Nitrophenol
3178-29-8	4-Propylheptane
98-51-1	4-tert-Butyltoluene
17012-93-0	5-(Trimethylsilyl)-2-pentanone
19689-19-1	5-Decene
7433-56-9	5-Decene, (E)-
56851-34-4	5-Methyl-2-undecane
17312-75-3	5-Methyl-5-propylnonane
4941-53-1	5-Undecene
62108-21-8	6-Ethyl-2-methyldecane
83-32-9	Acenaphthene
15067-26-2	Acenaphthene-d12
208-96-8	Acenaphthylene
75-07-0	Acetaldehyde
64-19-7	Acetic Acid
112-17-4	Acetic acid, decyl ester
112-14-1	Acetic acid, octyl ester

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
67-64-1	Acetone
75-05-8	Acetonitrile
98-86-2	Acetophenone
74-86-2	Acetylene
107-02-8	Acrolein
107-13-1	Acrylonitrile
309-00-2	Aldrin
28182-81-2	Aliphatic Polyisocyanate
107-18-6	Allyl Alcohol
5103-71-9	alpha-Chlordane
319-84-6	alpha-Hexachlorocyclohexane
80-56-8	alpha-Pinene
62-53-3	Aniline
120-12-7	Anthracene
7440-37-1	Argon
12674-11-2	Aroclor-1016
1104-28-2	Aroclor-1221
11141-16-5	Aroclor-1232
53469-21-9	Aroclor-1242
12672-29-6	Aroclor-1248
11097-69-1	Aroclor-1254
11096-82-5	Aroclor-1260
64742-96-75	Aromatic Petroleum Distillates
100-52-7	Benzaldehyde
71-43-2	Benzene
527-53-7	Benzene, 1,2,3,5-tetramethyl-
1076-43-3	Benzene-d6
92-87-5	Benzidine
56-55-3	Benzo(a)anthracene
50-32-8	Benzo(a)pyrene
205-99-2	Benzo(b)fluoranthene
192-97-2	Benzo(e)pyrene
191-24-2	Benzo(g,h,i)perylene
207-08-9	Benzo(k)fluoranthene
65-85-0	Benzoic Acid
3789-85-3	Benzoic acid, 2-[(trimethylsilyl)oxy]-,
93-58-3	Benzoic Acid, methyl ester
98-07-7	Benzotrichloride
98-88-4	Benzoyl Chloride
100-51-6	Benzyl Alcohol
319-85-7	beta-Hexachlorocyclohexane

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
123-35-3	beta-Myrcene
555-10-2	beta-Phellandrene
127-91-3	beta-Pinene
103-29-7	Bibenzyl
694-87-1	Bicyclo[4.2.0]octa-1,3,5-triene
92-52-4	Biphenyl
111-91-1	bis(2-Chloroethoxy) Methane
111-44-4	bis(2-Chloroethyl) Ether
108-60-1	bis(2-Chloroisopropyl) Ether
117-81-7	bis(2-Ethylhexyl)phthalate
542-88-1	bis(Chloromethyl) Ether
108-86-1	Bromobenzene
74-97-5	Bromochloromethane
75-27-4	Bromodichloromethane
75-25-2	Bromoform
74-83-9	Bromomethane
123-72-8	Butanal
106-97-8	Butane
106-65-6	Butanedioic Acid, Dimethyl Ester
123-86-4	Butyl Acetate
109-79-5	Butyl Mercaptan
104-51-8	Butylbenzene
85-68-7	Butylbenzylphthalate
123-95-5	Butylester Octadecanoic Acid
79-92-5	Camphene
404-86-4	Capsaicin
86-74-8	Carbazole
124-38-9	Carbon Dioxide
75-15-0	Carbon Disulfide
630-08-0	Carbon Monoxide
56-23-5	Carbon Tetrachloride
463-58-1	Carbonyl Sulfide
120-80-9	Catechol
111-15-9	Cellosolve Acetate (2-Ethoxyethyl Acetate)
12789-03-6	Chlordane
108-90-7	Chlorobenzene
3114-55-4	Chlorobenzene-d5
510-15-6	Chlorobenzilate
75-45-6	Chlorodifluoromethane
75-00-3	Chloroethane
67-66-3	Chloroform

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
74-87-3	Chloromethane
126-99-8	Chloroprene
100-44-7	Chlorotoluene
218-01-9	Chrysene
1719-03-5	Chrysene-d12
156-59-2	cis-1,2-Dichloroethene
10061-01-5	cis-1,3-Dichloropropene
638-04-0	cis-1,3-Dimethylcyclohexane
1476-11-5	cis-1,4-Dichloro-2-butene
38851-69-3	cis-1-Butyl-2-methylcyclopropane
4926-78-7	cis-1-Ethyl-4-methylcyclohexane
123-73-9	Crotonaldehyde
98-82-8	Cumene
13151-43-4	Cyclodecane, methyl-
110-82-7	Cyclohexane
3073-66-3	Cyclohexane, 1,1,3-trimethyl-
61141-79-5	Cyclohexane, 1,2-diethyl-1-methyl-
1839-63-0	Cyclohexane, 1,3,5-trimethyl-
1678-92-8	Cyclohexane, propyl-
108-93-0	Cyclohexanol
108-94-1	Cyclohexanone
2815-57-8	Cyclopentane, 1,2,3-trimethyl-
74752-93-5	Cyclopropane, 1,1,2,3-tetramethyl-
2511-91-3	Cyclopropane, pentyl-
3189-61-5	Cycloundecanone, oxime
2051-24-3	Decachlorobiphenyl
1618-22-0	Decahydro-2,6-dimethylnaphthalene
91-17-8	Decahydronaphthalene
541-02-6	Decamethylcyclopentasiloxane (D5)
112-31-2	Decanal
124-18-5	Decane
62237-99-4	Decane, 2,2,7-trimethyl-
13151-35-4	Decane, 5-methyl-
319-86-8	delta-Hexachlorocyclohexane
123-42-2	Diacetone Alcohol
53-70-3	Dibenz(a,h)anthracene
132-64-9	Dibenzofuran
124-48-1	Dibromochloromethane
1868-53-7	Dibromofluoromethane
74-95-3	Dibromomethane
79-43-6	Dichloroacetic Acid

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
79-36-7	Dichloroacetyl Chloride
75-43-4	Dichlorofluoromethane
77-73-6	Dicyclopentadiene
60-57-1	Dieldrin
110-81-6	Diethyl Disulfide
96-22-0	Diethyl Ketone
352-93-2	Diethyl Sulfide
112-34-5	Diethylene Glycol Monobutyl Ether
84-66-2	Diethylphthalate
108-83-8	Diisobutyl Ketone
109-87-5	Dimethoxymethane
624-92-0	Dimethyl Disulfide
115-10-6	Dimethyl Ether
1119-40-0	Dimethyl Glutarate
690-02-8	Dimethyl Peroxide
75-18-3	Dimethyl Sulfide
67-68-5	Dimethyl Sulfoxide
3658-80-8	Dimethyl Trisulfide
131-11-3	Dimethylphthalate
84-74-2	di-n-Butylphthalate
117-84-0	Di-n-Octylphthalate
122-39-4	Diphenylamine
6028-61-1	Dipropyl Trisulfide
34590-94-8	Dipropylene Glycol Monomethyl Ether
5989-27-5	D-Limonene
629-97-0	Docosane
112-54-9	Dodecanal
112-40-3	Dodecane
17312-57-1	Dodecane, 3-methyl-
959-98-8	Endosulfan I
33212-65-9	Endosulfan II
1031-07-8	Endosulfan Sulfate
72-20-8	Endrin
7421-93-4	Endrin Aldehyde
106-89-8	Epichlorohydrin
74-84-0	Ethane
64-17-5	Ethanol
74-85-1	Ethene
32357-83-8	Ether, hexyl pentyl
141-78-6	Ethyl Acetate
140-88-5	Ethyl Acrylate

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
100-41-4	Ethyl Benzene
105-54-4	Ethyl Butyrate
60-29-7	Ethyl Ether
97-64-3	Ethyl Lactate
75-08-1	Ethyl Mercaptan
97-63-2	Ethyl Methacrylate
624-89-5	Ethyl Methyl Sulfide
539-82-8	Ethyl Valerate
4806-61-5	Ethylcyclobutane
1640-89-7	Ethylcyclopentane
107-15-3	Ethylene Diamine
106-93-4	Ethylene Dibromide
107-21-1	Ethylene Glycol
75-21-8	Ethylene Oxide
96-45-7	Ethylene Thiourea
206-44-0	Fluoranthene
86-73-7	Fluorene
462-06-6	Fluorobenzene
50-00-0	Formaldehyde
64-18-6	Formic Acid
75-69-4	Freon 11
76-13-1	Freon 113
76-14-2	Freon 114
75-71-8	Freon 12
354-23-4	Freon 123
5103-74-2	gamma-Chlordane
7440-59-7	Helium
76-44-8	Heptachlor
1024-57-3	Heptachlor Epoxide
593-49-7	Heptacosane
111-71-1	Heptanal
142-82-5	Heptane
3074-71-3	Heptane, 2,3-dimethyl-
1001-89-4	Heptane, 2-chloro-
589-81-1	Heptane, 3-methyl-
118-74-1	Hexachlorobenzene
87-68-3	Hexachlorobutadiene
77-47-4	Hexachlorocyclopentadiene
67-72-1	Hexachloroethane
70-30-4	Hexachlorophene
1888-71-7	Hexachloropropene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
822-06-0	Hexamethylene-1,6-Diisocyanate
107-46-0	Hexamethylsiloxane
66-25-1	Hexanal
110-54-3	Hexane
3522-94-9	Hexane, 2,2,5-trimethyl-
1333-74-0	Hydrogen
7783-06-4	Hydrogen Sulfide
496-11-7	Indan
95-13-6	Indene
193-39-5	Indeno(1,2,3-c,d)pyrene
74-88-4	Iodomethane
75-28-5	Isobutane
78-83-1	Isobutanol
110-19-0	Isobutyl Acetate
513-44-0	Isobutyl Mercaptan
538-93-2	Isobutylbenzene
115-11-7	Isobutylene
97-85-8	Isobutylisobutyrate
78-84-2	Isobutyraldehyde
540-84-1	Isooctane
590-86-3	Isopentanal
78-78-4	Isopentane
123-51-3	Isopentyl Alcohol
78-59-1	Isophorone
108-20-3	Isopropyl ether
75-33-2	Isopropyl Mercaptan
108-21-4	Isopropylacetate
138-86-3	Limonene
58-89-9	Lindane
108-39-41	m,p-Cresol
620-23-51	m,p-Tolualdehyde
108-38-3	m,p-Xylene
535-77-3	m-Cymene
6398-62-5	Mercaptoacetic acid, bis(trimethylsilyl)
78-85-3	Methacrolein
126-98-7	Methacrylonitrile
74-82-8	Methane
67-56-1	Methanol
79-20-9	Methyl Acetate
110-43-0	Methyl Amyl Ketone
107-31-3	Methyl Formate

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
110-12-3	Methyl Isoamyl Ketone
40136-65-0	Methyl Isopropyl Disulfide
74-93-1	Methyl Mercaptan
80-62-6	Methyl Methacrylate
1634-04-4	Methyl tert-Butyl Ether
624-24-8	Methyl Valerate
108-87-2	Methylcyclohexane
96-37-7	Methylcyclopentane
75-09-2	Methylene Chloride
1192-37-6	Methylenecyclohexane
101-68-8	Methylenedi-p-phenyl Diisocyanate
8052-41-3	Mineral Spirits
141-43-5	Mono Ethanol amine (Ethanolamine)
110-91-8	Morpholine
620-23-5	m-Tolualdehyde
121-69-7	N,N-Dimethyl Aniline
86-56-6	N,N-Dimethyl-1-naphthylamine
127-19-5	N,N-Dimethylacetamide
68-12-2	N,N-Dimethylformamide
628-63-7	n-Amyl Acetate
91-20-3	Naphthalene
1146-65-2	Naphthalene-d8
71-36-3	n-Butanol
628-81-9	n-butyl ethyl ether
109-69-3	n-Butylchloride
463-82-1	Neopentane
54-11-5	Nicotine
98-95-3	Nitrobenzene
4165-60-0	Nitrobenzene-d5
7727-37-9	Nitrogen
75-52-5	Nitromethane
10024-97-2	Nitrous Oxide
872-50-4	n-Methyl Pyrrolidone
684-93-5	N-Methyl-N-Nitrosourea
120-94-5	NMP (1-Methylpyrrolidine)
62-75-9	N-Nitrosodimethylamine
621-64-7	N-Nitroso-di-n-propylamine
86-30-6	N-Nitrosodiphenylamine
59-89-2	N-Nitrosomorpholine
124-19-6	Nonanal
111-84-2	Nonane

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
31081-17-1	Nonane, 2-methyl-5-propyl-
17302-23-7	Nonane, 4,5-dimethyl-
28473-21-4	Nonanol
107-03-9	n-Propyl Mercaptan
90-04-0	o-Anisidine (2-Methoxyaniline)
29714-87-2	Ocimene
630-02-4	Octacosane
10544-96-4	Octadecane, 6-methyl-
434-64-0	Octafluorotoluene
556-67-2	Octamethylcyclotetrasiloxane (D4)
107-51-7	Octamethyltrisiloxane
124-13-0	Octanal
111-65-9	Octane
62016-14-2	Octane, 2,5,6-trimethyl-
2216-33-3	Octane, 3-methyl-
2216-34-4	Octane, 4-methyl-
62016-19-7	Octane, 6-ethyl-2-methyl-
527-84-4	o-Cymene
528-29-0	o-Dinitrobenzene
529-20-4	o-Tolualdehyde
95-53-4	o-Toluidine
7782-44-7	Oxygen
95-47-6	o-Xylene
106-51-4	Parabenzoquinone
99-87-6	p-Cymene
100-25-4	p-Dinitrobenzene
608-93-5	Pentachlorobenzene
76-10-7	Pentachloroethane
82-68-8	Pentachloronitrobenzene
87-86-5	Pentachlorophenol
3868-64-2	Pentalene, octahydro-2-methyl-
1438-82-0	Pentamethyldisiloxane
110-62-3	Pentanal
109-66-0	Pentane
4292-92-6	Pentylcyclohexane
198-55-0	Perylene
85-01-8	Phenanthrene
1517-22-2	Phenanthrene-d10
108-95-2	Phenol
4165-62-2	Phenol-d5
108-98-5	Phenyl Mercaptan

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
771-98-2	Phenylcyclohexene
95-54-5	p-Phenylenediamine
123-38-6	Propanal
74-98-6	Propane
109-60-4	Propyl Acetate
103-65-1	Propylbenzene
115-07-1	Propylene
108-65-6	Propylene Glycol Methyl Ether Acetate
75-56-9	Propylene Oxide
104-87-0	p-Tolualdehyde
106-49-0	p-Toluidine
129-00-0	Pyrene
25275-41-6	Pyridinium, 1-amino-, hydroxide, inner s
91-22-5	Quinoline
94-59-7	Safrole
513-53-1	sec-Butyl Mercaptan
135-98-8	sec-Butylbenzene
64741-65-7	Solvent Naphtha, heavy alkylate
100-42-5	Styrene
96-09-3	Styrene Oxide
2551-62-4	Sulfurhexafluoride
98904-43-9	Terphenyl-d14
994-05-8	tert-amyl methyl ether
75-65-0	tert-Butyl Alcohol
75-66-1	tert-Butyl Mercaptan
75-64-9	tert-Butylamine
98-06-6	tert-Butylbenzene
127-18-4	Tetrachloroethene
127-18-413	Tetrachloroethene-C13
629-59-4	Tetradecane
112-57-2	Tetraethylenepentamine
100-50-5	Tetrahydrobenzaldehyde
109-99-9	Tetrahydrofuran
110-01-0	Tetrahydrothiophene
3277-26-7	Tetramethylsiloxane
110-02-1	Thiophene
108-88-3	Toluene
584-84-9	Toluene 2,4-Diisocyanate
2037-26-5	Toluene-d8
8001-35-2	Toxaphene
156-60-5	trans-1,2-Dichloroethene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by Name

CAS #	Compound Name
822-50-4	trans-1,2-Dimethylcyclopentane
10061-02-6	trans-1,3-Dichloropropene
110-57-6	trans-1,4-Dichloro-2-butene
4923-78-8	trans-1-Ethyl-2-methylcyclohexane
6236-88-0	trans-1-Ethyl-4-methylcyclohexane
79-01-6	Trichloroethene
629-50-5	Tridecane
112-24-3	Triethylenetetramine
1120-21-4	Undecane
17301-30-3	Undecane, 3,8-dimethyl-
17301-31-4	Undecane, 3,9-dimethyl-
51-79-6	Urethane
108-05-4	Vinyl Acetate
593-60-2	Vinyl Bromide
75-01-4	Vinyl Chloride
107-25-5	Vinyl Methyl Ether

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
100-01-6	4-Nitroaniline
100-02-7	4-Nitrophenol
100-10-7	4-(Dimethylamino)benzaldehyde
1001-89-4	Heptane, 2-chloro-
1002-43-3	3-Methylundecane
10024-97-2	Nitrous Oxide
100-25-4	p-Dinitrobenzene
100-41-4	Ethyl Benzene
100-42-5	Styrene
10042-59-8	2-Propyl-1-heptanol
100-44-7	Chlorotoluene
100-50-5	Tetrahydrobenzaldehyde
100-51-6	Benzyl Alcohol
100-52-7	Benzaldehyde
10061-01-5	cis-1,3-Dichloropropene
10061-02-6	trans-1,3-Dichloropropene
100-80-1	3-Methylstyrene
101-55-3	4-Bromophenyl-phenyl Ether
101-68-8	Methylenedi-p-phenyl Diisocyanate
102-25-0	1,3,5-Triethylbenzene
1024-57-3	Heptachlor Epoxide
1031-07-8	Endosulfan Sulfate
103-29-7	Bibenzyl
103-65-1	Propylbenzene
104-51-8	Butylbenzene
104-76-7	2-Ethyl-1-hexanol
10482-56-1	(S)-alpha,alpha,4-Trimethyl-3-cyclohexene-1-methanol
104-87-0	p-Tolualdehyde
10487-71-5	2-Butenoylchloride
10487-96-4	1-Phenylcyclopentanol
105-05-5	1,4-Diethylbenzene
10544-96-4	Octadecane, 6-methyl-
105-54-4	Ethyl Butyrate
105-67-9	2,4-Dimethylphenol
106-35-4	3-Heptanone
106-43-4	4-Chlorotoluene
106-44-5	4-Methylphenol
106-46-7	1,4-Dichlorobenzene
106-47-8	4-Chloroaniline
106-49-0	p-Toluidine
106-51-4	Parabenzoquinone

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
106-65-6	Butanedioic Acid, Dimethyl Ester
106-68-3	3-Octanone
106-88-7	1,2-Epoxybutane
106-89-8	Epichlorohydrin
106-93-4	Ethylene Dibromide
106-94-5	1-Bromopropane
106-97-8	Butane
106-98-9	1-Butene
106-99-0	1,3-Butadiene
107-01-7	2-Butene
107-02-8	Acrolein
107-03-9	n-Propyl Mercaptan
107-05-1	3-Chloropropene
107-06-2	1,2-Dichloroethane
1071-26-7	2,2-Dimethylheptane
107-13-1	Acrylonitrile
107-15-3	Ethylene Diamine
107-18-6	Allyl Alcohol
107-21-1	Ethylene Glycol
107-25-5	Vinyl Methyl Ether
1072-85-1	1-Bromo-2-fluorobenzene
107-31-3	Methyl Formate
107-39-1	2,4,4-Trimethyl-1-pentene
107-46-0	Hexamethylsiloxane
107-51-7	Octamethyltrisiloxane
1075-38-3	1-(1,1-Dimethylethyl)-3-methylbenzene
1076-43-3	Benzene-d6
107-83-5	2-Methylpentane
107-87-9	2-Pentanone
107-98-2	1-Methoxy-2-propanol
108-05-4	Vinyl Acetate
108-08-7	2,4-Dimethylpentane
108-10-1	4-Methyl-2-pentanone
108-20-3	Isopropyl ether
108-21-4	Isopropylacetate
108-38-3	m,p-Xylene
108-39-4	3-Methylphenol
108-39-41	m,p-Cresol
108-60-1	bis(2-Chloroisopropyl) Ether
108-65-6	Propylene Glycol Methyl Ether Acetate
108-67-8	1,3,5-Trimethylbenzene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
108-68-9	3,5-Dimethylphenol
108-70-3	1,3,5-Trichlorobenzene
108-83-8	Diisobutyl Ketone
108-86-1	Bromobenzene
108-87-2	Methylcyclohexane
108-88-3	Toluene
108-90-7	Chlorobenzene
108-93-0	Cyclohexanol
108-94-1	Cyclohexanone
108-95-2	Phenol
108-98-5	Phenyl Mercaptan
109-60-4	Propyl Acetate
109-66-0	Pentane
109-67-1	1-Pentene
109-69-3	n-Butylchloride
109-79-5	Butyl Mercaptan
109-86-4	2-Methoxyethanol
109-87-5	Dimethoxymethane
109-99-9	Tetrahydrofuran
110-01-0	Tetrahydrothiophene
110-02-1	Thiophene
110-12-3	Methyl Isoamyl Ketone
110-19-0	Isobutyl Acetate
1104-28-2	Aroclor-1221
110-43-0	Methyl Amyl Ketone
110-54-3	Hexane
110-57-6	trans-1,4-Dichloro-2-butene
110-62-3	Pentanal
110-75-8	2-Chloroethyl Vinyl Ether
110-80-5	2-Ethoxy Ethanol
110-81-6	Diethyl Disulfide
110-82-7	Cyclohexane
110-91-8	Morpholine
11096-82-5	Aroclor-1260
11097-69-1	Aroclor-1254
111-15-9	Cellosolve Acetate (2-Ethoxyethyl Acetate)
111-27-3	1-Hexanol
11141-16-5	Aroclor-1232
111-44-4	bis(2-Chloroethyl) Ether
111-65-9	Octane
111-66-0	1-Octene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
111-71-1	Heptanal
111-76-2	2-Butoxyethanol
111-84-2	Nonane
111-91-1	bis(2-Chloroethoxy) Methane
1119-40-0	Dimethyl Glutarate
1120-21-4	Undecane
112-07-2	2-Butoxyethyl Acetate
112-14-1	Acetic acid, octyl ester
112-17-4	Acetic acid, decyl ester
112-24-3	Triethylenetetramine
112-31-2	Decanal
112-34-5	Diethylene Glycol Monobutyl Ether
112-40-3	Dodecane
112-54-9	Dodecanal
112-57-2	Tetraethylenepentamine
1146-65-2	Naphthalene-d8
115-07-1	Propylene
115-10-6	Dimethyl Ether
115-11-7	Isobutylene
117-81-7	bis(2-Ethylhexyl)phthalate
117-84-0	Di-n-Octylphthalate
118-74-1	Hexachlorobenzene
118-79-6	2,4,6-Tribromophenol
1192-37-6	Methylenecyclohexane
120-12-7	Anthracene
120-80-9	Catechol
120-82-1	1,2,4-Trichlorobenzene
120-83-2	2,4-Dichlorophenol
120-94-5	NMP (1-Methylpyrrolidine)
121-14-2	2,4-Dinitrotoluene
121-69-7	N,N-Dimethyl Aniline
122-39-4	Diphenylamine
122-66-7	1,2-Diphenylhydrazine
123-05-7	2-Ethylhexanal
123-35-3	beta-Myrcene
123-38-6	Propanal
123-42-2	Diacetone Alcohol
123-51-3	Isopentyl Alcohol
123-54-6	2,4-Pentanedione
123-72-8	Butanal
123-73-9	Crotonaldehyde

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
123-86-4	Butyl Acetate
123-91-1	1,4-Dioxane
123-95-5	Butylester Octadecanoic Acid
124-11-8	1-Nonene
124-13-0	Octanal
124-18-5	Decane
124-19-6	Nonanal
124-38-9	Carbon Dioxide
124-48-1	Dibromochloromethane
12672-29-6	Aroclor-1248
12674-11-2	Aroclor-1016
126-98-7	Methacrylonitrile
126-99-8	Chloroprene
127-18-4	Tetrachloroethene
127-18-413	Tetrachloroethene-C13
127-19-5	N,N-Dimethylacetamide
12789-03-6	Chlordane
127-91-3	beta-Pinene
129-00-0	Pyrene
131-11-3	Dimethylphthalate
13151-34-3	3-Methyldecane
13151-35-4	Decane, 5-methyl-
13151-43-4	Cyclodecane, methyl-
132-64-9	Dibenzofuran
1333-74-0	Hydrogen
13466-78-9	3-Carene
13475-81-5	2,2,3,3-Tetramethylhexane
13475-82-6	2,2,4,6,6-Pentamethylheptane
135-01-3	1,2-Diethylbenzene
135-98-8	sec-Butylbenzene
137-32-6	2-Methyl-1-butanol
138-86-3	Limonene
13925-03-6	2-Ethyl-6-methylpyrazine
140-67-0	1-Methoxy-4-(2-propenyl)benzene
140-88-5	Ethyl Acrylate
141-32-2	2-Propenoic Acid Butyl Ester
141-43-5	Mono Ethanol amine (Ethanolamine)
141-78-6	Ethyl Acetate
141-93-5	1,3-Diethylbenzene
142-28-9	1,3-Dichloropropane
142-82-5	Heptane

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
1438-82-0	Pentamethyldisiloxane
14720-74-2	2,2,4-Trimethylheptane
1476-11-5	cis-1,4-Dichloro-2-butene
15067-26-2	Acenaphthene-d12
1517-22-2	Phenanthrene-d10
156-59-2	cis-1,2-Dichloroethene
156-60-5	trans-1,2-Dichloroethene
15726-15-5	3-Methyl-4-heptanone
15892-23-6	2-Butanol
1613-52-1	2-Ethylthiacyclohexane
1618-22-0	Decahydro-2,6-dimethylnaphthalene
1634-04-4	Methyl tert-Butyl Ether
1640-89-7	Ethylcyclopentane
16596-38-6	1,1-Bis-(2-methylpropyl) Hydrazine
16747-26-5	2,2,4-Trimethylhexane
16747-28-7	2,3,3-Trimethylhexane
1678-92-8	Cyclohexane, propyl-
16789-46-1	3-Ethyl-2-methylhexane
17012-93-0	5-(Trimethylsilyl)-2-pentanone
17060-07-0	1,2-Dichloroethane-d4
1708-29-8	2,5-Dihydrofuran
1719-03-5	Chrysene-d12
17301-23-4	2,6-Dimethylundecane
17301-25-6	2,8-Dimethylundecane
17301-30-3	Undecane, 3,8-dimethyl-
17301-31-4	Undecane, 3,9-dimethyl-
17301-94-9	4-Methylnonane
17302-23-7	Nonane, 4,5-dimethyl-
17302-28-2	2,6-Dimethylnonane
17302-32-8	3,7-Dimethylnonane
17302-37-3	2,2-Dimethyldecane
17312-53-7	3,6-Dimethyldecane
17312-57-1	Dodecane, 3-methyl-
17312-64-0	2,2-Dimethylundecane
17312-75-3	5-Methyl-5-propylnonane
17312-80-0	2,4-Dimethylundecane
1745-81-9	2-(2-Propenyl)phenol
1758-88-9	2-Ethyl-1,4-dimethyl benzene
18344-37-1	2,6,10,14-Tetramethylheptadecane
1839-63-0	Cyclohexane, 1,3,5-trimethyl-
1868-53-7	Dibromofluoromethane

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
1888-71-7	Hexachloropropene
191-24-2	Benzo(g,h,i)perylene
192-97-2	Benzo(e)pyrene
193-39-5	Indeno(1,2,3-c,d)pyrene
19689-19-1	5-Decene
198-55-0	Perylene
20265-35-4	2-Methoxy-3-nitropyridine
20324-32-7	1-(2-Methoxy-1-methylethoxy)-2-propanol
2037-26-5	Toluene-d8
2051-24-3	Decachlorobiphenyl
2051-30-1	2,6-Dimethyloctane
205-99-2	Benzo(b)fluoranthene
20627-54-7	2-Ethyl-5-methyl-1,3-dioxane
206-44-0	Fluoranthene
207-08-9	Benzo(k)fluoranthene
208-96-8	Acenaphthylene
218-01-9	Chrysene
2213-23-2	2,4-Dimethylheptane
2216-33-3	Octane, 3-methyl-
2216-34-4	Octane, 4-methyl-
22370-55-4	10-Methyl-1-undecene
2245-38-7	2,3,5-Trimethylnaphthalene
2295-35-4	2-Pyrrolidinethione
2499-59-4	2-Propenoic acid, octyl ester
2511-91-3	Cyclopropane, pentyl-
25275-41-6	Pyridinium, 1-amino-, hydroxide, inner s
25414-22-6	2,2,3-Trimethyl-1-butene
2551-62-4	Sulfurhexafluoride
26472-00-4	3a,4,7,7a-Tetrahydro-4,7-methano-1H-indene
271-89-6	2,3-Benzofuran
2815-57-8	Cyclopentane, 1,2,3-trimethyl-
28182-81-2	Aliphatic Polyisocyanate
28473-21-4	Nonanol
2847-72-5	4-Methyldecane
29548-02-5	2,5,5-Trimethyl-1,3,6-heptatriene
29714-87-2	Ocimene
3073-66-3	Cyclohexane, 1,1,3-trimethyl-
3074-71-3	Heptane, 2,3-dimethyl-
309-00-2	Aldrin
31081-17-1	Nonane, 2-methyl-5-propyl-
31081-18-2	3-Methyl-5-propylnonane

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
3114-55-4	Chlorobenzene-d5
31295-56-4	2,6,11-Trimethyldodecane
3178-29-8	4-Propylheptane
3189-61-5	Cycloundecanone, oxime
319-84-6	alpha-Hexachlorocyclohexane
319-85-7	beta-Hexachlorocyclohexane
319-86-8	delta-Hexachlorocyclohexane
320-60-5	2,4-Dichloro-1-(trifluoromethyl)benzene
321-60-8	2-Fluorobiphenyl
3221-61-2	2-Methyloctane
32357-83-8	Ether, hexyl pentyl
3277-26-7	Tetramethylsiloxane
33212-65-9	Endosulfan II
34004-69-8	3(2H)-Furanone, dihydro-5-isopropyl-
34590-94-8	Dipropylene Glycol Monomethyl Ether
3522-94-9	Hexane, 2,2,5-trimethyl-
352-93-2	Diethyl Sulfide
354-21-2	1,2,2-Trichloro-1,1-difluoroethane
354-23-4	Freon 123
354-58-5	1,1,1-Trichlorotrifluoroethane
3658-80-8	Dimethyl Trisulfide,
367-12-4	2-Fluorophenol
3711-38-4	1,2-Bis-(1-methylpropyl) Hydrazine
3789-85-3	Benzoic acid, 2-[(trimethylsilyl)oxy]-,
38072-94-5	1-Methylnaphthalene-d10
3855-82-1	1,4-Dichlorobenzene-d4
3868-64-2	Pentalene, octahydro-2-methyl-
38851-69-3	cis-1-Butyl-2-methylcyclopropane
40136-65-0	Methyl Isopropyl Disulfide
404-86-4	Capsaicin
4057-42-5	2-Octene, 2,6-dimethyl-
4165-60-0	Nitrobenzene-d5
4165-62-2	Phenol-d5
4292-19-7	1-Iodododecane
4292-92-6	Pentylcyclohexane
430-57-9	1,2-Dichloro-1-fluoroethane
434-64-0	Octafluorotoluene
460-00-4	4-Bromofluorobenzene
462-06-6	Fluorobenzene
463-58-1	Carbonyl Sulfide
463-82-1	Neopentane

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
464-17-5	1,7,7-Trimethylbicyclo[2.2.1]hept-2-ene
471-43-2	1,1-Dichloro-2,2-difluoroethane
4748-78-1	4-Ethylbenzaldehyde
4806-61-5	Ethylcyclobutane
488-23-3	1,2,3,4-Tetramethylbenzene
4923-78-8	trans-1-Ethyl-2-methylcyclohexane
4926-78-7	cis-1-Ethyl-4-methylcyclohexane
4926-90-3	1-Ethyl-1-methylcyclohexane
4938-52-7	1-Hepten-3-ol
4941-53-1	5-Undecene
496-11-7	Indan
49622-18-6	3,3,4-Trimethyldecane
50-00-0	Formaldehyde
50-29-3	4,4-DDT
50-32-8	Benzo(a)pyrene
510-15-6	Chlorobenzilate
5103-71-9	alpha-Chlordane
5103-74-2	gamma-Chlordane
51-28-5	2,4-Dinitrophenol
513-36-0	1-Chloro-2-methylpropane
513-44-0	Isobutyl Mercaptan
513-53-1	sec-Butyl Mercaptan
51-79-6	Urethane
526-73-8	1,2,3-Trimethylbenzene
526-75-0	2,3-Dimethylphenol
527-53-7	Benzene, 1,2,3,5-tetramethyl-
527-60-6	2,4,6-Trimethylphenol
527-84-4	o-Cymene
528-29-0	o-Dinitrobenzene
52896-90-9	3-Ethyl-5-methylheptane
529-20-4	o-Tolualdehyde
532-27-4	2-Chloroacetophenone
534-22-5	2-Methylfuran
534-52-1	4,6-Dinitro-2-methylphenol
53469-21-9	Aroclor-1242
535-77-3	m-Cymene
53-70-3	Dibenz(a,h)anthracene
538-93-2	Isobutylbenzene
53907-59-8	2-Pentene, 3-ethyl-4,4-dimethyl-
53941-19-8	3,4,4-Trimethyl-2-hexene
539-82-8	Ethyl Valerate

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
540-36-3	1,4-Difluorobenzene
540-84-1	Isooctane
541-02-6	Decamethylcyclotrasiloxane (D5)
54-11-5	Nicotine
541-73-1	1,3-Dichlorobenzene
542-88-1	bis(Chloromethyl) Ether
54410-98-9	4,6,8-Trimethyl-1-nonene
554-01-8	4-Amino-5-methyl-2(1H)-pyrimidinone
555-10-2	beta-Phellandrene
556-67-2	Octamethylcyclotetrasiloxane (D4)
55702-61-9	4,4,5-Trimethyl-2-hexane
560-21-4	2,3,3-Trimethylpentane
56-23-5	Carbon Tetrachloride
563-58-6	1,1-Dichloropropene
563-80-4	3-Methyl-2-butanone
56-55-3	Benzo(a)anthracene
565-59-3	2,3-Dimethylpentane
565-75-3	2,3,4-Trimethylpentane
56851-34-4	5-Methyl-2-undecane
569-41-5	1,8-Dimethylnaphthalene
571-61-9	1,5-Dimethylnaphthalene
573-98-8	1,2-Dimethylnaphthalene
575-41-7	1,3-Dimethylnaphthalene
575-43-9	1,6-Dimethylnaphthalene
576-26-1	2,6-Dimethylphenol
5779-94-2	2,5-Dimethylbenzaldehyde
581-40-8	2,3-Dimethylnaphthalene
581-42-0	2,6-Dimethylnaphthalene
582-16-1	2,7-Dimethylnaphthalene
583-48-2	3,4-Dimethylhexane
584-84-9	Toluene 2,4-Diisocyanate
58-89-9	Lindane
58-90-2	2,3,4,6-Tetrachlorophenol
589-34-4	3-Methylhexane
589-53-7	4-Methylheptane
589-81-1	Heptane, 3-methyl-
590-86-3	Isopentanal
591-76-4	2-Methylhexane
591-78-6	2-Hexanone
592-13-2	2,5-Dimethylhexane
592-41-6	1-Hexene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
592-76-7	1-Heptene
593-49-7	Heptacosane
593-60-2	Vinyl Bromide
594-20-7	2,2-Dichloropropane
59-50-7	4-Chloro-3-methylphenol
59-89-2	N-Nitrosomorpholine
5989-27-5	D-Limonene
6028-61-1	Dipropyl Trisulfide
60-29-7	Ethyl Ether
6032-29-7	2-Pentanol
60-57-1	Dieldrin
606-20-2	2,6-Dinitrotoluene
608-93-5	Pentachlorobenzene
611-14-3	2-Ethyltoluene
61141-79-5	Cyclohexane, 1,2-diethyl-1-methyl-
616-44-4	3-Methylthiophene
616-55-7	4,6-Di(1,1-dimethylethyl)-2-methylphenol
620-14-4	3-Ethyltoluene
62016-14-2	Octane, 2,5,6-trimethyl-
62016-19-7	Octane, 6-ethyl-2-methyl-
62016-28-8	2,2,6-Trimethyloctane
620-23-5	m-Tolualdehyde
620-23-51	m,p-Tolualdehyde
6203-18-5	4-Dimethylaminocinnamaldehyde
62108-21-8	6-Ethyl-2-methyldecane
62108-22-9	2,5,9-Trimethyldecane
62108-23-0	2,5,6-Trimethyldecane
62108-25-2	2,6,7-Trimethyldecane
62108-31-0	4-Ethyl-2,2,6,6-tetramethylheptane
621-64-7	N-Nitroso-di-n-propylamine
62237-98-3	2,2,4-Trimethyldecane
62237-99-4	Decane, 2,2,7-trimethyl-
62238-11-3	2,3,5-Trimethyldecane
62238-12-4	2,3,6-Trimethyldecane
62238-33-9	1-Ethyl-2-propylcyclohexane
622-96-8	4-Ethyltoluene
623-27-8	1,4-Benzenedicarboxyaldehyde
62338-09-4	2,2,3-Trimethyldecane
623-46-1	1,2-Dichloroethyl Ethyl Ether
6236-88-0	trans-1-Ethyl-4-methylcyclohexane
624-24-8	Methyl Valerate

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
624-64-6	(E)-2-Butene
624-89-5	Ethyl Methyl Sulfide
624-92-0	Dimethyl Disulfide
62-53-3	Aniline
62-75-9	N-Nitrosodimethylamine
628-63-7	n-Amyl Acetate
628-81-9	n-butyl ethyl ether
629-20-9	1,3,5,7-Cyclooctatetraene
629-50-5	Tridecane
629-59-4	Tetradecane
629-97-0	Docosane
630-02-4	Octacosane
630-08-0	Carbon Monoxide
630-20-6	1,1,1,2-Tetrachloroethane
634-66-2	1,2,3,4-Tetrachlorobenzene
638-02-8	2,5-Dimethylthiophene
638-04-0	cis-1,3-Dimethylcyclohexane
6398-62-5	Mercaptoacetic acid, bis(trimethylsilyl)
64-17-5	Ethanol
6418-41-3	3-Methyltridecane
64-18-6	Formic Acid
64-19-7	Acetic Acid
646-06-0	1,3-Dioxolane
64741-65-7	Solvent Naphtha, heavy alkylate
64742-96-75	Aromatic Petroleum Distillates
65-85-0	Benzoic Acid
66-25-1	Hexanal
67-56-1	Methanol
67-63-0	2-Propanol
67-64-1	Acetone
67-66-3	Chloroform
67-68-5	Dimethyl Sulfoxide
67-72-1	Hexachloroethane
68-12-2	N,N-Dimethylformamide
684-93-5	N-Methyl-N-Nitrosourea
68998-21-0	1,1-Dimethyl-2-(3-methyl-1,3-butadienyl)-cyclopropane
690-02-8	Dimethyl Peroxide
694-87-1	Bicyclo[4.2.0]octa-1,3,5-triene
697-82-5	2,3,5-Trimethylphenol
7005-72-3	4-Chlorophenyl-phenyl Ether
70-30-4	Hexachlorophene

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
71-23-8	1-Propanol
71-36-3	n-Butanol
71-43-2	Benzene
7145-20-2	2,3-Dimethyl-2-hexene
7154-80-5	3,3,5-Trimethylheptane
71-55-6	1,1,1-Trichloroethane
72-20-8	Endrin
72-43-5	4,4-Methoxychlor
72-54-8	4,4-DDD
72-55-9	4,4-DDE
7283-47-8	(3,3-Dimethyl-1-methylenebutyl)benzene
73105-67-6	1-Iodo-2-methylundecane
7421-93-4	Endrin Aldehyde
7433-56-9	5-Decene, (E)-
7440-37-1	Argon
7440-59-7	Helium
74630-52-7	(E)-6-Methyl-3-undecene
74645-98-0	2,7,10-Trimethyldodecane
74663-83-5	2,5-Dimethyl-3-methylene-1,5-heptadiene
74663-86-8	1-Ethyl-2-heptylcyclopropane
74752-93-5	Cyclopropane, 1,1,2,3-tetramethyl-
74-82-8	Methane
74-83-9	Bromomethane
74-84-0	Ethane
74-85-1	Ethene
74-86-2	Acetylene
74-87-3	Chloromethane
74-88-4	Iodomethane
74-93-1	Methyl Mercaptan
74-95-3	Dibromomethane
74-97-5	Bromochloromethane
74-98-6	Propane
75-00-3	Chloroethane
75-01-4	Vinyl Chloride
75-05-8	Acetonitrile
75-07-0	Acetaldehyde
75-08-1	Ethyl Mercaptan
75-09-2	Methylene Chloride
75-15-0	Carbon Disulfide
75163-97-2	2,6-Dimethyloctadecane
75-18-3	Dimethyl Sulfide

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
75-21-8	Ethylene Oxide
75-25-2	Bromoform
75-27-4	Bromodichloromethane
75-28-5	Isobutane
75-29-6	2-Chloropropane
75-33-2	Isopropyl Mercaptan
75-34-3	1,1-Dichloroethane
75-35-4	1,1-Dichloroethene
75-37-6	1,1-Difluoroethane
75-43-4	Dichlorofluoromethane
75-45-6	Chlorodifluoromethane
75-52-5	Nitromethane
75-56-9	Propylene Oxide
75-64-9	tert-Butylamine
75-65-0	tert-Butyl Alcohol
75-66-1	tert-Butyl Mercaptan
75-69-4	Freon 11
75-71-8	Freon 12
75-83-2	2,2-Dimethylbutane
76-10-7	Pentachloroethane
76-13-1	Freon 113
76-14-2	Freon 114
763-29-1	2-Methyl-1-pentene
76-44-8	Heptachlor
7667-55-2	(1-alpha,2-alpha,3-beta)-1,2,3-Trimethylcyclohexane
767-59-9	1-Methyl-1H-indene
768-49-0	(2-Methyl-1-propenyl)benzene
771-98-2	Phenylcyclohexene
7727-37-9	Nitrogen
77-47-4	Hexachlorocyclopentadiene
77-73-6	Dicyclopentadiene
7782-44-7	Oxygen
7783-06-4	Hydrogen Sulfide
78-59-1	Isophorone
78-78-4	Isopentane
78-83-1	Isobutanol
78-84-2	Isobutyraldehyde
78-85-3	Methacrolein
78-87-5	1,2-Dichloropropane
78-93-3	2-Butanone (Methyl Ethyl Ketone)
79-00-5	1,1,2-Trichloroethane

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
79-01-6	Trichloroethene
79-20-9	Methyl Acetate
79-34-5	1,1,2,2-Tetrachloroethane
79-36-7	Dichloroacetyl Chloride
79-43-6	Dichloroacetic Acid
79-46-9	2-Nitropropane
79-92-5	Camphene
8001-35-2	Toxaphene
8052-41-3	Mineral Spirits
80-56-8	alpha-Pinene
80-62-6	Methyl Methacrylate
821-97-6	(Z)-3-Undecene
822-06-0	Hexamethylene-1,6-Diisocyanate
822-50-4	trans-1,2-Dimethylcyclopentane
82-68-8	Pentachloronitrobenzene
83-32-9	Acenaphthene
84-66-2	Diethylphthalate
84-74-2	di-n-Butylphthalate
85-01-8	Phenanthrene
85-34-7	2,3,6-Trichlorophenylacetic Acid
85-68-7	Butylbenzylphthalate
86-30-6	N-Nitrosodiphenylamine
86-56-6	N,N-Dimethyl-1-naphthylamine
86-73-7	Fluorene
86-74-8	Carbazole
871-83-0	2-Methylnonane
872-05-9	1-Decene
872-50-4	n-Methyl Pyrrolidone
872-55-9	2-Ethylthiophene
874-41-9	1-Ethyl-2,4-dimethylbenzene
87-61-6	1,2,3-Trichlorobenzene
87-68-3	Hexachlorobutadiene
877-09-8	2,4,5,6-Tetrachloro-m-xylene
87-86-5	Pentachlorophenol
88-06-2	2,4,6-Trichlorophenol
88-74-4	2-Nitroaniline
88-75-5	2-Nitrophenol
90-04-0	o-Anisidine (2-Methoxyaniline)
90-12-0	1-Methylnaphthalene
90-13-1	1-Chloronaphthalene
90-15-3	1-Naphthol

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
91-08-7	2,6-Toluene Diisocyanate
91-17-8	Decahydronaphthalene
91-20-3	Naphthalene
91-22-5	Quinoline
91-57-6	2-Methylnaphthalene
91-58-7	2-Chloronaphthalene
91-59-8	2-Naphthylamine
91-94-1	3,3'-Dichlorobenzidine
921-47-1	2,3,4-Trimethylhexane
92-52-4	Biphenyl
92-67-1	4-Aminobiphenyl
92-87-5	Benzidine
934-80-5	4-Ethyl-1,2-dimethylbenzene
93-58-3	Benzoic Acid, methyl ester
94-59-7	Safrole
95-13-6	Indene
95-47-6	o-Xylene
95-48-7	2-Methylphenol (o-Cresol)
95-49-8	2-Chlorotoluene
95-50-1	1,2-Dichlorobenzene
95-51-2	2-Chloroaniline
95-53-4	o-Toluidine
95-54-5	p-Phenylenediamine
95-57-8	2-Chlorophenol
95-63-6	1,2,4-Trimethylbenzene
95-65-8	3,4-Dimethylphenol
95-80-7	2,4-Diaminotoluene
95-87-4	2,5-Dimethylphenol
95-94-3	1,2,4,5-Tetrachlorobenzene
95-95-4	2,4,5-Trichlorophenol
959-98-8	Endosulfan I
96-09-3	Styrene Oxide
96-12-8	1,2-Dibromo-3-chloropropane
96-14-0	3-Methylpentane
96-18-4	1,2,3-Trichloropropane
96-22-0	Diethyl Ketone
96-37-7	Methylcyclopentane
96-45-7	Ethylene Thiourea
97-63-2	Ethyl Methacrylate
97-64-3	Ethyl Lactate
97-85-8	Isobutylisobutyrate

Chemical Abstracts Registry Numbers (CAS #'s) Sorted by CAS#'s

CAS #	Compound Name
98-06-6	tert-Butylbenzene
98-07-7	Benzotrichloride
98-51-1	4-tert-Butyltoluene
98-82-8	Cumene
98-83-9	(1-Methylethenyl)benzene (alpha Methyl Styrene)
98-86-2	Acetophenone
98-88-4	Benzoyl Chloride
98904-43-9	Terphenyl-d14
98-95-3	Nitrobenzene
99-09-2	3-Nitroaniline
994-05-8	tert-amyl methyl ether
99-62-7	1,3-Diisopropylbenzene
99-65-0	1,3-Dinitrobenzene
99-84-3	4-Methylene-1-(1-methylethyl)cyclohexene
99-87-6	p-Cymene
99-96-7	4-Hydroxybenzoic Acid

STANDARD OPERATING PROCEDURES

SOP#	TITLE	REVISION NUMBER	REVIEW/ REVISION DATE
#1	Project Management	0	5/12/99
#2	Analysis of Volatile Organic Compounds in VOST Cartridges and Condensates by EPA SW-846 Method 5041A	15	6/11/99
#3	Analysis of SemiVolatile Organic Compounds by EPA SW-846 Method 8270C	2	6/11/99
#4	Preparation of Tenax and Tenax/Charcoal Tubes for VOST or Ambient Air Samples	5	4/19/99
#5	Analysis of VOCs in Ambient Air using Compendium TO-17 and Modified EPA SW-846 Method 5041A	0	10/01/98
#6	Analysis of Volatile Organic Compounds in SUMMA Polished Canisters by EPA Method TO-14/TO-14A/TO-15	14	5/13/99
#7	Preparation of SUMMA Canisters for Sampling	10	4/19/99
#8	Analysis of Oxygen, Nitrogen, Methane, Carbon Monoxide, Carbon Dioxide and NMOC by ASTM Method D1946	6	5/12/99
#9	Analysis of Phenol and Cresols by EPA Method TO-8	2	10/1/98
#10	Analysis of Semi-Volatile Compounds Collected on PUF Cartridges by EPA Method TO-13/Modified SW-846 8270	4	6/11/98
#11	Analysis of Aldehydes and Ketones by EPA Methods TO-11 TO-11, Modified SW-846 0011, (BIF 0011)/8315A	1	6/11/99
#12	NLU	NA	NA
#13	Analysis of Sulfur Compounds by Modified ASTM Method 5504	3	9/4/98
#14	Preparation of PUF/XAD2 Media	1	6/11/99
#15	Extraction of Ambient Air & MM5 Samples for Semi-Vol. Analysis	0	9/11/98
#16	Sorbent Tube Tracking Procedures	2	6/11/99
#17	Safe Lifting Procedures	1	6/1/99
#18	Handling of Spills in the Sample Receiving Area	2	4/19/99
#19	Refrigerator and Freezer Content and Temperature Monitoring Documentation	2	6/1/99
#20	Analysis of Volatile Compounds in Air by Modified EPA Method 18	1	6/11/99
#21	Standard Preparation Documentation	3	6/11/99
#22	Data Review	4	6/7/99

STANDARD OPERATING PROCEDURES

SOP#	TITLE	REVISION NUMBER	REVIEW/ REVISION DATE
#23	Electronic Deliverable Generation and Review	3	6/14/99
#24	Storage and Disposal of Hazardous Wastes	2	11/19/98
#25	NLU	NA	NA
#26	Analysis of Pesticides/PCBs Collected on PUF/XAD Cartridges using TO-4 Modified EPA Methods 8081A & 8082	2	10/1/98
#27	Internal Audit Program	5	5/13/99
#28	On-site Analysis of Volatile Organic Compounds by EPA Method TO-14/TO-14A/TO-15	0	4/19/99
#29	On-site Analysis of Volatile Organic Compounds Using Portable GC/MS System	0	4/19/99
#30	Laboratory Security	2	6/11/99
#31	Laboratory Safety	1	1/26/99
#32	Generation, Updating and Distribution of Controlled Documents	2	5/13/99
#33	Inventory of Neat Materials and Certified Compound Mixes	2	1/26/99
#34	Certification of Test Equipment	3	6/14/99
#35	NLU	NA	NA
#36	Analysis of Non-Methane Organic Compounds (NMOC) by EPA Method TO12	2	6/14/99
#37	NLU	NA	NA
#38	Analysis of Volatile Organic Compounds in Summa Polished Canisters via GC/MS-SIM EPA Method TO-14	Under Revision	
#39	NLU	NA	NA
#40	Analysis of Low Level Vinyl Chloride in Air via the Prefractionator Interface Using GC/ECD	2	6/11/99
#41	Preparation of Hardcopy Analytical Reports Using ADT	0	6/11/99
#42	NLU	NA	NA
#43	Analysis of Benzene, Toluene, Ethylbenzene, Xylenes and Total Petroleum Hydrocarbons - EPA Method TO-3	Under Revision	
#44	NLU	NA	NA
#45	Preparation and Review of Laboratory Narratives	2	6/14/99

STANDARD OPERATING PROCEDURES

SOP#	TITLE	REVISION NUMBER	REVIEW/ REVISION DATE
#46	Writing Standard Operating Procedures	1	6/11/99
#47	Implementation and Testing of Atlas Modules	1	6/14/99
#48	Preparation and Review of Control Charts	1	4/26/99
#49	Analysis of Oxygen, Nitrogen, Methane, Carbon Dioxide and NMO by EPA Method 25C	2	6/14/99
#50	Receiving and Tracking of Samples	1	6/11/99
#51	NLU	NA	NA
#52	Manual Peak Integration - GC/MS	1	5/6/99
#53	BFB Tune Check Spectrum Generation	1	6/14/99
#54	Analysis of Natural Gases by ASTM Method D1945	1	6/11/99
#55	Electronic Archival of GC and LC Analytical Instrument Data	0	5/13/99
#56	NLU	NA	NA
#57	Manual Peak Integration - Gas Chromatography	1	6/11/99
#58	Dissolved Gas Analysis in Water Using a GC Headspace Technique	1	2/12/99
#59	NLU	NA	NA
#60	Canister Pressurization	1	4/28/99
#61	Corrective Action Procedure	1	5/13/99
#62	Preparation of 2,4-Dinitrophenylhydrazine (DNPH) Reagent for Use in EPA Methods 0011 (BIF 0011), TO-5, and CARB 430 Sampling	1	6/14/99

NA - Not applicable

NLU - No longer in use

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